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CO-OP ELECTRIFICATION ADVISER TRAINING OUTLINE

7

HOUSEHOLD REFRIGERATION AND THE FREEZING OF FOODS

REA

RURAL ELECTRIFICATION ADMINISTRATION U.S. DEPT. OF AGRICULTURE

Purposes of this Outline

This is one of a series of outlines prepared by REA as an aid in planning and arranging training schools for co-op electrification advisers. Each outline deals with a power use subject or with some aspect of cooperative principles and practice or with a particular method or technique of getting information to people. These are the three principal fields in which electrification advisers need to be skilled. It is suggested that committees planning such training schools keep in mind the need of training in all three types of subject matter and, insofar as practicable, make use of the outlines in a balanced combination. In most cases, two or three subjects can be covered in a five-day school. This booklet contains both suggested subject matter and suggestions as to how the material might be presented with a suitable time schedule indicated. The booklet is thus useful as a guide to committees in charge of setting up training schools, as an aid to the instructors, and as a subject matter manual that may be distributed to participants as a reminder and reference to the material studied at the school.

Information of current outlines completed and of those in preparation may be obtained from the REA General Field Representative or by writing to the Area Director of the Rural Electrification Administration, U. S. Department of Agriculture, Washington 25, D. C.

Suggested

Co-op Electrification Adviser

Training Outline

#7

HOUSEHOLD REFRIGERATION EQUIPMENT AND THE FREEZING OF FOODS

Rural Electrification Administration

U. S. Department of Agriculture

April 1953

HOUSEHOLD REFRIGERATION AND THE FREEZING OF FOODS

THE PURPOSE

The purpose of a household refrigeration equipment and freezing of foods training school is to help electrification advisers with their refrigeration equipment problems. Since the goal of most farm families is to own and use a household refrigerator and/or home freezer, the electric cooperative's power use and member education program should be aimed at helping the farm family members determine the benefits to be obtained from such equipment.

These benefits depend primarily on the correct choice of equipment and the ways in which it is used and maintained.

An attempt has been made to evaluate, condense, and adapt the information on household refrigeration equipment and the freezing of foods material, so that it may be used as a brief outline of subject-matter text.

The main objectives of the training activity on household refrigeration equipment and freezing of foods are to assist electrification advisers to:

a. Acquire basic subject-matter information on household refrigeration equipment to enable advisers to aid farm families with their refrigeration problems.

b. Use many types and makes of refrigeration equipment as possible to determine the factors which may effect the selection, the use, and care of the equipment for specified situations.

c. Practice the processing, wrapping, and freezing of different types of food.

d. To become more interested in the possibilities for self-education in the subject of household refrigeration in order to better discharge their job responsibilities.

e. Obtain suggested methods and techniques for presenting the materials to farm families.

The three-day program is divided into lecture, discussion, demonstration, and laboratory practice.

The illustrative material includes movies, charts, slides, publications, and samples of packaging materials.

Provision is made for those attending to become familiar with a wide variety of refrigeration equipment, to observe different methods of presentations, and to actively participate in the training activity.

SUGGESTED PROGRAM FOR REFRIGERATION EQUIPMENT AND FREEZING OF FOODS TRAINING SCHOOL

First Day

9:00 a.m.	Objectives of Training School	Chairman of State Power Use Committee
9:30 a.m.	The Value of Refrigeration (The Family)	Specialist in fields of refrigeration. College, Extension or REA.
10:15 a.m.	The Fundamentals of Refrigeration	Qualified engineer who can trace development and physics of refrigeration, should lead this discussion. College, Research, Commercial or REA Agricultural Engineer or Agricultural Extension Engineer.
11:15 a.m.	Recess	
11:30 a.m.	Types and designs of Household Refrigerators	Commercial, College, Agricultural Extension Service, Research or REA.
12:00	Lunch Afternoon Chairman	Co-op Manager, Board Member or Member of Power Use Committee
1:00 p.m.	Discussion and Questions	Leaders of discussion above staff members.

1:30 p.m.	Demonstration of Household Refrigerators - Selection Operation and Care Points (Food should be used)	Commercial Home Economist, Extension, REA
2:30 p.m.	Laboratory Examination of Refrigerators - Parts and Special Features - Group Participation.	REA
3:15 p.m.	Recess	
3:30 p.m.	Laboratory - Continued	Same
4:00 p.m.	Movie	Discussion Leader REA Regional Home Economist or Agricultural Engineer.

Second Day

	Morning Session Chairman	Co-op Manager, Board Member or Member of Power Use Committee
8:30 a.m.	Evaluation of Previous Day's Work	Electrification Adviser
8:40	Types of Home Freezers and Factors Affecting Their Choice	Research, Extension College or REA
10:40	Recess	
10:50	Walk-in Refrigerators	College, Extension, REA
11:40	Discussion and Questions	
12:00	Lunch	
	Afternoon Chairman	Co-op Manager, Board Member or Member of Power Use Committee
1:00 p.m.	Contributions of Research to Freezers and Freezing of Food	Research Working in Field of Refrigeration and Freezing of Foods.
2:30	Varieties of Fruits and Vegetables Suitable for Freezing	College or Extension Horticulturist
3:15	Recess	
3:30	Demonstration of Selecting Packaging Materials	Commercial, College Extension Service
4:30	Laboratory, Study of Home Freezers Discussion and Questions, Group Participation	REA
5:00	Adjourn	

Third Day

	Morning Session	
8:30 a. m.	Home Freezer Demonstration Including the Processing and Packaging of Fruits and Vegetables	Extension Service, College Food Specialist
9:30	Film Strip - "Freezing of Strawberries and Vegetables" Bureau of Human Nutrition and Home Economics	
9:45	Demonstration - Freezing Meats, Poultry and Ready Cooked Foods.	Extension Food Specialist, College Food or Meat Specialist
10:30	Recess	
10:40	Freezer Laboratory Practice (Prepare and Freeze Typical Foods)	REA
12.15 p.m.	Lunch	
	Afternoon Session Chairman	Co-op Manager, Board Member or Member of Power Use Committee
1:15	Freezer Demonstration on Cooking of Frozen Foods, the Thawing of Fruits and Vegetables -"From Freezer to Table"	Food Specialist. College, Extension Food Specialist or Commercial Home Economist
2:15	Plans and Methods of Teaching Refrigeration and Freezing Equipment	Home Economics Education Teacher or Supervisor
3:30	Recess	
3:45	The group develop an outline on methods of presenting refrigeration equipment -information for use in meeting the refrigeration needs of members during the national emergency.	REA or Chairman of Power Use Committee.
5:00	Adjourn	

THE HISTORY AND VALUE OF REFRIGERATION

1. History

The beginnings of refrigeration date back to the days of the cave man who found his meat kept for several days when it was put in a cold cave. Records show that cooling of food took place in China as far back as 1000 B.C. Alexander the Great had trenches filled with snow to cool the wine for the soldiers. Later, food was kept in a cool cellar or in the "cold room" in winter. Many people living today remember the spring house for the storage of milk and butter during the warm months of the year.

Then, followed the time when ice was cut, hauled, and placed in the ice house for use the following summer. During the 17th century, ice was sold in France under government regulation. The first commercial delivery of ice in America was in 1802. It necessitated the making of an icebox large enough to hold both the ice and the food. This was the forerunner, no doubt, of the modern refrigerator.

The early methods of refrigeration were difficult and not too reliable. The first attempt to develop mechanical refrigeration dates to 1755. It was not until after 1890 that mechanical refrigeration made progress and as late as 1927 before there was widespread refrigeration of foods in the United States. Even today, it is estimated that there are about one-fourth of the families in this country without refrigeration.

2. The Value of Refrigeration

Household refrigerators and freezers offer an easy way to keep foods fresh and palatable. They help both in food preservation and the development of food flavors. The main values of refrigeration to the family are:

a. To Control Food Spoilage

Although spoilage is a natural process, it is known that refrigeration helps to control it. All foods have within them chemical agents known as enzymes. These enzymes cause foods to ripen or mature and

unless their action is retarded the food soon spoils. Enzymes are special proteins built up by the plant or animal for the purpose of hastening the chemical reactions that must go on if the tissue is to live. After a plant or an animal is killed, enzymatic action increases rapidly unless some method is used to retard it. This action as well as the growth of micro-organisms which get on the food from outside sources is retarded when stored in a cool or cold place.

Some types of spoilage are due to the presence of micro-organisms, --molds, yeast, and bacteria. Molds can be seen readily. The action of yeast, however, is not easily seen and except for producing an undesirable flavor and odor is ordinarily harmless. Bacteria are of two types: the harmless ones, like those which cause milk to sour, and the harmful kind that cause disease.

b. <u>To Control Harmful Bacteria</u>

Bacteria cannot be seen without magnification, but experiments have proven that these plants require a certain amount of moisture and warmth for growth. Under favorable conditions, bacteria grow at a rapid rate at high temperatures. Fifty degrees Fahrenheit has been chosen as a convenient, economical, maximum temperature for household refrigerators. Meat, milk and egg products are particularly susceptible to bacterial growth. The proper degree of coldness controls their growth. Fifty F. is not a critical temperature in the preservation of foods, and certain foods require lower temperatures for preservation. Modern household refrigerators are built to produce cool temperatures from 36 to 45 F., which provides a means for controlling the rapid growth of bacteria. The reason that it is necessary to retard the growth of harmful bacteria in food is that the more bacteria present, the less chance there is for the body to fight off infection.

Milk is easily contaminated with bacteria. That is the reason state governing bodies insist that milk be protected. Even with all of the care that is taken - healthy cows, clean handling, pasteurization, and cooling - bacteria may multiply rapidly unless the milk is refrigerated. The following chart taken from "Milk in Household Refrigerators," U. S. Department of Agriculture, shows the rate of increase of bacterial growth in milk of different temperatures.

GROWTH OF BACTERIA IN MILK AT VARYING TEMPERATURES

Temperature:	Rate of Increase*			
	24 hours	48 hours	72 hours	92 hours
35	2.4	2.6	4.5	5.9
40	2.5	3.2	6.3	21.6
45	3.4	23.2	83.5	152.5
50	10.6	63.5	114.5	2,467.7
55	25.4	174.1	849.0	6,438.8

There are similar figures on meats and other perishable foods, which show that the bacterial growth is rapid unless retarded by proper refrigeration.

c. To Help Protect Against Poisoning

The growth of some types of bacteria produce toxic substances which cause food poisoning. Deaths and illnesses from food poisoning can be substantially reduced by refrigerating foods at temperatures which retard bacteria growth.

d. To Help Retain Vitamins

Many vitamins are lost quickly when the food containing them is stored at room temperature. Some vitamins are stable while others show a loss unless some method is used to retard them. The vitamin content of fruits and vegetables closely parallels their freshness, and since it is known that refrigeration keeps them fresh, it also safeguards the vitamins.

Vitamin A - (Carotene) Vegetables held at low temperatures show little loss of carotene, while at room temperature there is a gradual loss.

*Rate of increase means number of times original number multiplies.

Since some of this vitamin is lost on exposure to the air, it is recommended that fruits and vegetables be stored in uncut form and that peas be stored in pods.

Vitamin B2 - (Riboflavin) Vitamin B2 is destroyed by light; low temperature and darkness are favorable to the retention of it, refrigeration is necessary if Vitamin B2 is to provide its maximum benefit to the family.

Vitamin C - (Ascorbic Acid) Vitamin C is destroyed easily and is sensitive to oxidation. The losses may be reduced by refrigeration.

e. To Make Foods More Palatable

Crisp salad greens, firm butter, chilled fruit juices and milk are more palatable than those which are served without the benefit of refrigeration. Without refrigeration, frozen desserts and jellied salads and desserts would not be readily available.

f. To Help Provide Better Nutrition

Refrigeration offers the possibility of a variety of foods and good management in meal planning. The refrigerator with a compartment for storing frozen foods at 0 F., provides for a still greater variety of frozen foods.

g. To Help Provide a Higher Standard of Living

The modern refrigerator and freezer of adequate size enables the homemaker to purchase foods in quantity, or to preserve excess garden produce. It is also possible to take advantage of "good buys" when available, as well as to take advantage of the saving effected by purchasing foods in quantity.

h. To Provide Convenience

Adequate refrigeration aids in food purchasing, meal preparation and work simplification, provided a plan is followed for making efficient use of equipment. In order to obtain maximum convenience, the equipment (refrigerator and freezer) must be located in or near the kitchen with a working surface adjoining the door-opening side of the cabinet.

PRINCIPLES OF REFRIGERATION

1. Physical Principles of Refrigeration and Mechanical Parts

The mechanical operation of a refrigerator is based on the principles that evaporation of a liquid into a gas absorbs heat and the condensation of a gas into a liquid gives off heat.

A familiar example of the principle of refrigeration is a pan of hot water on a range. Every pan of boiling water is like a refrigerator, but probably few people realize it. When a pan of water is heated on a range its temperature rises and continues to do so until the water boils and steam is formed. The rise in temperature then stops, even though the range is still putting heat into the water. The change to steam takes up all of the heat, being added and, until all of the water is evaporated, its temperature will go no higher.

Water in an open pan is under the pressure of the atmosphere around it. Normal atmospheric pressure at sea level is 14.7 pounds per square inch. Under a pressure of 14.7 pounds per square inch, water boils at 212 F. If the pressure is increased as it is in a pressure cooker, boiling temperature is increased. When the pressure in the pressure cooker reaches 15 pounds per square inch (above atmospheric pressure) the water in it boils at about 250 F.

When the atmospheric pressure is decreased the boiling temperature of the water is lowered. If the water is placed in a closed container and the air is pumped out, the pressure is lowered. As a result this water will boil at a lower temperature; sometimes as low as 50 F. to 60 F. If this water were in a room with a temperature of 100 F. it would cool the room because heat would go from the room into the water. As long as the vacuum pump did not allow the pressure on the water to rise, it would continue to boil at this comparatively low temperature and continue to cool the room until it had all boiled away.

There are reasons why commercial refrigerators do not use water as a refrigerant in this manner and thus function in exactly this way. One reason is

that the temperatures needed are generally below the freezing point of water. Even in household refrigerators where the temperatures in the cabinets are around 40 F. to 50 F., the temperatures in the mechanism that cools the cabinet must be below freezing. Still another reason is that in order to get water to boil at a temperature below 50 F. such a high vacuum is needed that it is impractical outside of a laboratory.

Refrigerators differ from the description given above in two ways. The first difference is that they use liquids other than water as refrigerants. The liquids used freeze at temperatures far below the freezing point of water, and they boil under reasonable pressures at temperatures that in some cases are 20 F. below zero or lower. The other difference is that there is machinery to collect the vapor as it boils and to condense it so that it can be used over and over again.

2. Refrigerants

Many different liquids have been used for refrigerants. Here are some of them: ammonia, sulphur dioxide, methylchloride, methylene chloride (Carrene), methylformate, isobutane (Freezol), carbon dioxide, dichlorodifluoromethane (F-12 or Freon-12) and dichlorotetrafluoromethane (F-114 or Freon-114). Except for carbon dioxide, each of these has, at one time or another, been used in ordinary household refrigerators, although F-12, F-22 and F-114 are now most common. Except for carbon dioxide, a few refrigerators using each of these are still in operation in homes throughout the country. Carbon dioxide is used only for producing extremely low temperatures such as -40 F. or lower. Ammonia is used in gas and kerosene refrigerators and in some large capacity electric machines above the sizes found in household refrigerators.

3. Boiling Pressures of Refrigerants

In the example above, water boiled at different temperatures by changing the pressure. The same thing is true of the various refrigerants, but each has its own pressure under which it will boil at any one particular temperature.

Before the needed pressures are discussed, it is necessary to understand how pressures are measured.

The normal atmospheric pressure is about 14.7 lbs. per square inch, but ordinarily pressure gauges on machinery give the pressures in relation to the atmosphere. For example, a gauge reading of 5 lbs. means that the pressure is 5 lbs. above the atmospheric pressure. This means that pressures below atmospheric pressures show negative readings on the gauges.

There are several ways in which pressures can be designated. One of these is in pounds per square inch; another is in the number of feet of water that the pressure will support; a third is in the number of inches of mercury that the pressure will support. It is common practice in the refrigeration industry to measure pressures below atmospheric in terms of inches of mercury and to measure pressures above atmospheric in terms of pounds per square inch. One inch of mercury equals .49 pounds per square inch, and one pound per square inch equals 2.04 inches of mercury.

The following table gives the boiling pressures of some of the common refrigerants at various temperatures. Those pressures that are designated "-" and "in." show how much the pressure is below atmospheric and are in terms of inches of mercury. Those that are designated "+" and "lbs." show how much the pressure is above atmospheric and are in terms of pounds per square inch.

Boiling Pressures of Refrigerants at Different Temperatures

Temperature	Freon-12	Freon-114	Sulphur Dioxide	Ammonia	Methyl Chloride
-20 F.	+ 0.5 lb.	-22.9 in.	-17.9 in.	+ 3.6 lb.	-6.1 in.
-15 F.	+ 2.4 lb.	-21.7 in.	-16.1 in.	+ 6.2 lb.	-3.0 in.
-10 F.	+ 4.5 lb.	-20.6 in.	-13.9 in.	+ 9.0 lb.	+0.2 in.
- 5 F.	+ 6.8 lb.	-19.2 in.	-11.5 in.	+12.2 lb.	+2.0 lb.
0 F.	+ 9.2 lb.	-17.8 in.	- 8.9 in.	+15.7 lb.	+4.1 lb.
5 F.	+11.9 lb.	-16.0 in.	- 5.9 in.	+19.6 lb.	+6.2 lb.
10 F.	+14.7 lb.	-14.3 in.	- 2.6 in.	+23.8 lb.	+8.7 lb.
15 F.	+17.7 lb.	-12.3 in.	+ 0.5 lb.	+28.4 lb.	+11.2 lb.
20 F.	+21.1 lb.	- 7.5 in.	+ 2.5 lb.	+33.5 lb.	+14.1 lb.
25 F.	+24.6 lb.	- 7.5 in.	+ 4.6 lb.	+39.0 lb.	+17.2 lb.
30 F.	+28.5 lb.	- 5.0 in.	+ 7.0 lb.	+45.0 lb.	+20.6 lb.

From the figures in the above table, it can be seen that if the evaporator in a refrigerator is to operate at 15 F. above zero and the refrigerant is Freon-12, the machinery would have to be such that a pressure of 17.7 lbs. is maintained in the evaporator. For Freon-14, the pressure would be a minus 12.3 inches of mercury (a partial vacuum); for sulphur dioxide, 0.5 lbs.; for ammonia, 28.4 lbs., and for methyl chloride, 11.2 lbs.

4. The Evaporator

The part of a refrigerator in which the refrigerant boils and evaporates is known as the evaporator. In household refrigerators, the evaporator is the part in which the ice cube trays are kept. In immersion milk coolers, it is the copper tubes around the outside of the milk can compartment or in one end of this compartment. In home freezers, it may be plates or coils in the storage or freezing compartment or it may be tubes built into the walls.

5. Refrigerator Operation

If the refrigerant were discarded after it had been used once, the refrigerating machinery would be nothing more than an evaporator to which new refrigerant is added as the old boils away. A pump is necessary to maintain pressure in the evaporator. Since refrigerants are expensive, it is necessary to include machinery for condensing the refrigerant vapor and returning it to the evaporator as a liquid again.

Condensing a vapor into a liquid requires just the reverse process of evaporating it. When there is a concentrated vapor and its temperature is lowered by removing heat, there is a specific temperature at which it condenses. If steam (water vapor) is under normal atmospheric pressure and heat is removed its temperature will drop to 212 F. but no further until it has all condensed to liquid. If the pressure is above atmospheric, the condensation will take place above 212 F. The refrigerants behave in a similar way. The part of the refrigerator in which the condensation takes place is known as the condenser.

The condenser in many commercial refrigerators and in some farm fruit and vegetable refrigerators are cooled by water, but in practically all household

refrigeration equipment they are cooled by air. In order to give off heat, the condenser must be warmer than the air around it. The machinery must maintain pressures in the condenser high enough so that the refrigerant will condense at temperatures above the highest expected temperature. The following table gives the pressures at which some of the common refrigerants condense at various temperatures.

Condensing Pressures of Refrigerants at Various Temperatures

Temp.	Freon-12	Freon-114	Sulphur Dioxide	Ammonia	Methyl Chloride
90 F.	≠ 99.6 lb.	≠24.0 lb.	≠ 56.6 lb.	≠165.9 lb.	≠ 87.3 lb.
95 F.	≠108.1 lb.	≠27.5 lb.	≠ 62.9 lb.	≠181.1 lb.	≠ 95.4 lb.
100 F.	≠116.9 lb.	≠31.0 lb.	≠ 69.8 lb.	≠197.2 lb.	≠104.4 lb.
105 F.	≠126.2 lb.	≠34.9 lb.	≠ 77.2 lb.	≠214.2 lb.	≠113.5 lb.
110 F.	≠136.0 lb.	≠38.8 lb.	≠ 85.1 lb.	≠232.2 lb.	≠118.3 lb.
115 F.	≠146.3 lb.	≠43.1 lb.	≠ 93.3 lb.	≠251.5 lb.	----------
120 F.	≠157.1 lb.	≠47.7 lb.	≠106.2 lb.	≠271.7 lb.	≠139.3 lb.
125 F.	≠168.4 lb.	≠52.5 lb.	≠111.7 lb.	≠293.1 lb.	----------
130 F.	≠180.2 lb.	≠57.5 lb.	≠121.8 lb.	≠315.6 lb.	≠161.3 lb.
135 F.	≠192.6 lb.	≠62.9 lb.	≠132.5 lb.	≠339.4 lb.	----------
140 F.	≠205.5 lb.	≠68.6 lb.	≠143.9 lb.	≠364.4 lb.	≠185.3 lb.

7. The Compressor

Since the pressure in the evaporator is lower than the pressure in the condenser, a pump is placed between the evaporator and the condenser, to pump the refrigerant vapor from the evaporator into the condenser. This mechanism is known as the compressor. It must have enough capacity to remove the refrigerant vapor as fast as the vapor is formed by the boiling refrigerant in the evaporator, and it must be capable of forcing this vapor against the condensing pressure in the condenser.

8. The Expansion Valve

The liquid that condenses in the condenser is ready to be returned to the evaporator for re-use, but the pressure on it is far above that at which it will boil in the evaporator to prevent the high pressure. This makes it necessary to place a device in the pipe between the condenser and the evaporator. Various types of devices will do this but the most common ones are known as expansion valves. Another device that has been used in a

few household refrigerators which accomplishes the same task is a capillary tube. The expansion valve is located at the place where the pipe from the condenser enters the evaporator.

9. Liquid Receivers

It is usually desirable to have some more refrigerant in the refrigerator mechanism than just the amount needed for its operation. This eliminates the need for extremely accurate measuring of the amount put in, and compensates for insignificant leakage. Many refrigerators have a special device on them in which the excess refrigerant is stored. This device is known as a liquid receiver.

The liquid receiver is a container installed in the pipe between the condenser and the expansion valve.

10. Dehydrators

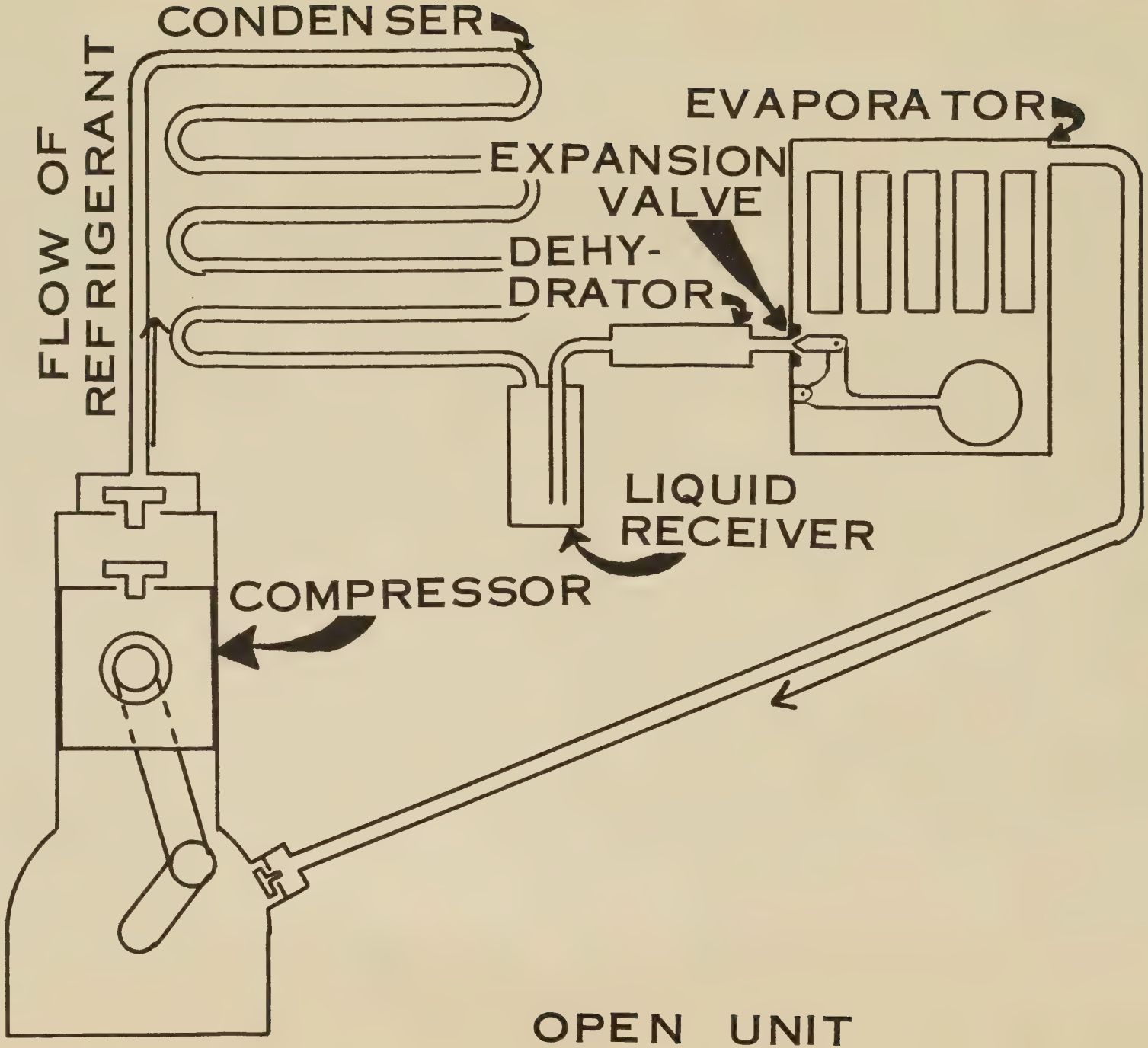
It is almost impossible to be sure that there is no moisture in a refrigerating machine. This moisture may freeze in small passages, it may react with the refrigerant producing undesirable results, or it may effect the lubrication of the compressor. Many manufacturers install a dehydrator which collects and holds the small amount of moisture that may be present. These dehydrators are small containers filled with some substance that has a strong affinity for water. Silica gel is one of the substances used.

The dehydrator is installed in the pipe between the condenser and the expansion valve so that the liquid refrigerant passes through it.

11. The Refrigeration Cycle

The sketch on page No. 18a. shows the refrigeration cycle. Study it to learn how it works. Start with the evaporator.

a. The liquid refrigerant boils in the evaporator and in the process absorbs heat. It continues to boil as long as the temperature around it is higher than its boiling temperature. As it boils, the vaporized refrigerant rises to the top of the evaporator.


CONDENSER
FLOW OF REFRIGERANT
EVAPORATOR
EXPANSION VALVE
DEHY-DRATOR
LIQUID RECEIVER
COMPRESSOR

OPEN UNIT

b. The compressor draws the vaporized refrigerant from the evaporator. By drawing off the refrigerant as it vaporizes, it keeps the pressure in the evaporator from rising and thus keeps the refrigerant boiling at the desired temperature.

c. The vaporized refrigerant is drawn into the compressor under relatively low pressure and forced out into the condenser at a much higher pressure. When a gas is compressed its temperature increases. The compression of the refrigerant gas in the compressor raises its temperature considerably above the temperature of the air in the surrounding room.

d. In the condenser, the heat of the vaporized refrigerant is radiated into the air around it. When the refrigerant temperature is reduced to a certain point, it condenses into a liquid again, and flows to the bottom of the condenser. This liquid is still under the same pressure as the gas coming from the compressor and it is still at the condensing temperature.

e. As the warm liquid refrigerant flows from the condenser to the expansion valve, it passes through the liquid receiver and the dehydrator. These two devices have no significance in the cycle except that the liquid receiver holds the excess refrigerant in the system beyond the amount immediately needed, and the dehydrator removes any water which may be mixed with the refrigerant.

f. The expansion valve allows the needed liquid refrigerant to flow from the condenser into the evaporator. In this way it maintains the correct amount in the evaporator for best operation. The refrigerant passes from the high pressure in the condenser to the low pressure in the evaporator as it goes through the expansion valve. When it gets under this low pressure, it boils and vaporizes again, and the cycle repeats itself as long as the compressor continues to run.

12. Temperature Controls

Temperature controls on all electric refrigerators operate the starting and stopping of the motors that drive the compressors. They are of two types: pressure controls and thermal controls. Pressure controls are electric switches that are operated by

the pressures in the evaporator. Since any change in pressure changes the boiling temperature of the refrigerant in the evaporator, the temperature of the refrigerant can be controlled by changing the pressure. This type of control starts the compressor motor when the pressure in the evaporator rises to a predetermined point and stops the motor when it falls to another predetermined point. Thermal controls are electric switches that are operated by the air temperature in the refrigerated compartment. The control starts the motor when the temperature rises to a predetermined point, and stops it when the air temperature falls to another predetermined point.

The thermal control is more sensitive to the air temperatures within the refrigerator than the pressure control. This is because the ice formed on the evaporator forms a thermal insulation between the air and the evaporator and changes the relationship between the temperature in the evaporator and the temperature in the storage compartment.

13. Heat Exchanger

Warm refrigerant from the liquid receiver carries heat into the storage space and must be cooled. A cool refrigerant gas from the evaporator leaves the refrigerator and is warmed outside. By placing the pipe containing the warm refrigerant liquid next to the pipe with the cool refrigerant gas, the heat can be transferred from one to the other and the efficiency of the machine increased. The device that brings these two pipes into contact with each other is the heat exchanger.

14. Overload Control

An overload safety control is a device to prevent serious damage to refrigeration equipment in case of excessive motor load or low voltage. It opens the motor circuit when an overload condition occurs. Such a condition might take place when too many appliances are connected on the same electric circuit with the refrigerator or freezer. Another difficulty may be that the appliance is overloaded with warm foods.

The overload device allows the motor to start operating, and then turns it off repeatedly until the overloading is relieved.

The control device consists of a small heater coil through which all motor current passes and a pair of contacts, one of which is mounted on a thermostatic blade. In case the motor draws excessive

current, as in an overload, the heater coil becomes hot enough to bend the thermostatic blade and open the overload contacts; thus opening the motor circuit and stopping the mechanism.

15. How Heat and Refrigeration Are Measured 1/

Heat is a form of energy. It could be measured in terms of horsepower, watts, or any other terminology which is used in the measurement of other forms of energy. Instead of employing terminology that is used in the measurement of energy in other forms, quantities of heat, however, are usually measured throughout the United States in British thermal units. A British thermal unit is commonly referred to as Btu. One Btu. is the quantity of heat necessary to raise 1 lb. of water 1 degree Fahrenheit. Throughout many parts of the world, heat is measured in calories. A calorie is the amount of heat necessary to raise 1 gram of water 1 degree Centigrade. One Btu. is 252 calories.

The quantity of heat in a substance, and its temperature, are not the same thing. Temperature may be defined as the condition of a body which determines the transfer of heat to or from other bodies. The difference between temperature and quantity of heat is illustrated in the following example. A cup of boiling water may be at 212 F. It contains a certain number of Btu's. If the cup of boiling water is poured into a tub of cold water, the temperature of the mixture will be much below 212 F., but obviously all of the heat will still be there; the total number of Btu. in the two volumes of water will not be changed.

When a substance changes from a solid to a liquid, as when ice changes to water, a considerable quantity of heat is absorbed. The heat is used in bringing about the change of state of the substance and, therefore, does not change its temperature.

Before ice can melt, its temperature rises to 32 F. The addition of heat does not raise its temperature further until the ice is melted. Each pound of ice absorbs 144 Btu's while melting. Thus a pound of water at 32 F. contains 144 more Btu than does a pound of ice at 32 F. When ice is used for

1/ Earl L. Arnold, Farm Refrigerated Storage, Cornell University Agricultural Experiment Station Bulletin 724, September 1939, Ithaca, New York.

refrigeration, it is this quantity of heat which is absorbed from the refrigerated area to change the ice to water that produces most of the cooling effect.

Ice was used for refrigeration before mechanical refrigerating machines were developed. In order to measure the refrigeration, the amount of ice that melted was measured. Thus it became conventional to refer to the refrigeration produced by melting 1 pound of ice as a pound of refrigeration. With the development of mechanical refrigerators of large capacity, thus unit of measurement became too small for convenience. Therefore the refrigeration industry adopted the amount of heat absorbed by melting 1 ton of ice as the unit. This unit is known as a ton of refrigeration.

Since melting 1 pound of ice requires the absorption of 144 Btu., melting 1 ton of ice would require the absorption of 288,000 (2,000 x 144) Btu. Thus 1 ton of refrigeration is the effect produced by removing 288,000 Btu. of heat.

In order to standardize machines, a time had to be set in which the machine would accomplish a certain amount of refrigeration. The generally accepted time is 24 hours. Thus a 5-ton machine is capable of producing 5 tons of refrigeration in 24 hours.

1/ Ibid.

HOUSEHOLD REFRIGERATORS

Introduction

The purpose of the household refrigerator is to preserve food by cooling it below the temperatures of the surrounding atmosphere. The household refrigerator provides cold storage space for small quantities of frozen food.

Modern automatic refrigerators are self-regulating and generally hold safe regulating temperatures, operate efficiently, and last for many years.

1. Size

The refrigerator must be large enough to meet family needs. Since these vary greatly, it is difficult to state exact size to be selected. However, it should have plenty of room for the storage of dairy products, bottled goods, fresh foods, leftovers, and special foods. Some authorities suggest that a family of two will need at least six cubic feet of refrigerator space. For larger families add one cubic foot for each two additional persons plus two cubic feet for guests.

Household refrigerators may be purchased in sizes from 3 to 14 cubic feet. The overall dimensions vary in widths from 23 to 34 inches, depths from 23¼ to 29-3/4 inches, heights from 53 to 64 inches. The table top models are available in sizes from 4 to 7 cubic feet.

In determining the size of a refrigerator for a family, these points may be checked:

a. The size of the family plus any possible changes.

b. The number of other persons regularly eating at home.

c. The food habits of the family: (1) The quantities and kinds of food purchased at one time; (2) the need for keeping extra supplies on hand; (3) the amount of food produced at home.

d. The frequency of shopping.

e. The amount of entertaining done.

2. Types of Household Refrigerators

There are two types of household refrigerators on the market, the conventional, equipped with a vertical or horizontal evaporator, and the freezer-refrigerator combination. Either the horizontal evaporator model or combination freezer-refrigerator may have a cold wall food storage compartment.

a. The Conventional Type

The vertical evaporator - This evaporator occupies about 5 per cent of the total storage space in the cabinet. It is U-shaped and is located inside the cabinet at the upper center or side. The freezing coils are in the evaporator walls and in the quick freezing shelf. The evaporators under normal operation holds temperatures of about 20 F. to 25 F.

The food storage space is cooled by air circulation (convection currents). Heat flows from a warmer to a cooler body; the evaporator is the cooler body while the food and storage compartment is the warmer body. The warm air gathered from the food and food compartment, moves upward and thus the heat is absorbed by the refrigerant in the evaporator. As the warm air passes over the evaporator, it is cooled and much of the moisture is deposited on the evaporator in the form of frost. The cooled air drops into the storage compartment, completing the air passage cycle.

Since the moisture in the air collects on the evaporator and the cold air is dry, the foods need to be covered to maintain their moisture.

The horizontal evaporator - This evaporator occupies the area across the top of the cabinet. In most refrigerators it is about 17 per cent of the total storage space. This compartment is practically the same as the vertical evaporator except it is in a horizontal position. The coils are found in the walls and bottom of the shell. Most of these compartments are insulated or baffled so that the temperatures in side the evaporators range from 10 to 15 F. These evaporators usually have the capacity to store a greater amount of frozen food than the vertical type. However, the temperature fluctuation may be high during each "on" and "off" cycle. Foods in most horizontal type refrigerators need to be covered.

In some models, there are additional refrigerating coils in the wall of the cabinet and these are a part of the primary refrigerating system. This provides partial moist cold refrigeration (high humidity) in the food storage compartment. Since there are some convection air currents in the food storage compartment, the foods may be stored uncovered only a short time. This type should not be confused with the two-zone or combination freezer refrigerator.

b. The Combination Freezer Refrigerator

This type combines ordinary refrigeration of the food with a freezing compartment. (1.5 to 2 cubic feet.) The compartments are operated by a primary and a secondary refrigeration system, but it has only one refrigeration unit. The primary system in these refrigerators is the same as in the conventional refrigerator. The secondary system consists of a separate set of coils (with separate refrigerant) located around the sides and back of the storage compartment. The liquid refrigerant changes to a vapor when the secondary coils absorb heat from the moist cold (high humidity) food storage compartment. The vapor is light and rises to the highest point of the secondary system. When the restrictor valve is brought in contact with the transfer plate coil (heat exchanger) of the primary system, the intense cold turns the light vapor back into a liquid. The liquid refrigerant then flows by gravity to the bottom of the system where the cycle starts again.

The reason for a secondary system in some models is to provide added cooling to the refrigerator or to take care of the lower temperature of the freezer-storage compartment. Each compartment is separately insulated, has a separate door, and a separate temperature control. The freezing compartment temperature does not affect the food storage compartment. The temperature in the freezer compartment may be maintained at 0 F. For fast freezing the control may be set to provide a lower temperature. After the food is frozen, reset the dial to its normal setting.

These freezing compartments are capable of storing from 25 to 50 pounds of food, dependent upon the kind of foods frozen.

In most models of the combination refrigerator freezers, the non-frozen food section has a cold wall construction. Excess moisture which collects on the cold inner walls of the food storage cabinet drains into a container in the cabinet or it passes into a drain near the compressor unit where it is evaporated.

3. The Cold Wall Refrigerator - High Humidity

In most cold wall refrigerators, the evaporator or freezing area is separated from the normal food storage compartment by a shelf or baffle. A heavy gasket surrounds the outer rims of the evaporator shell, this produces close contact with the door lining to prevent air circulation into the lower compartment. In these systems, there is little air movement which results in high humidity.

The refrigeration coils encircle the walls of the cabinet as well as surround the evaporator. These coils maintain a near constant temperature and produce a comparatively high humidity. There is only a minimum of moist air circulation in the compartment. As a result, little moisture is removed from the food when not covered.

At least one model contains a super moist compartment in addition to the moist cold area. The area is enclosed by a door which provides retarded air circulation and produces the higher humidity.

The excess moisture in these refrigerators forms moisture condensation on the walls. The excess moisture is drained into a container or onto a horizontal refrigerated plate located on the upper back wall of the storage compartment.

Some refrigerators are constructed with a baffle and a thermostatically controlled damper. These regulate the air circulation to provide proper amounts of moisture for normal food storage.

4. Design

Refrigerators may be purchased in a number of overall dimensions. The trend in refrigerators is for a greater cubic foot capacity within a given cabinet size. The food storage compartment in many refrigerators extends from the top to almost the floor. The

refrigeration mechanism is more compact which allows for an increased interior size with the same exterior dimensions. This allows for more convenient arrangement in limited kitchen space. The top of the cabinet is either curved or flat. The flat topped ones can serve occasionally as a counter for placing foods before storing them in the refrigerator. The base of the cabinet either rests flat on the floor or off the floor where there is toe space between the floor and cabinet. The door may be either a right or left opening one. If the bottom of the interior cabinet is slightly lower than the door frame, it is easier to clean when foods are accidentally spilled.

5. Manufacturer and Dealer

If a refrigerator is built by a reputable manufacturer, and sold by a reliable dealer it is reasonably certain that it will give good service. They are in a position to stand back of the guarantee that the refrigerator is free from defects in material and workmanship and provide repair services. Usually, the refrigerating system has a guarantee for five years and the cabinet and parts for one year. If a refrigerator is to be purchased by mail order, arrangements are made for servicing through a local agency. If this service is not provided a definite understanding should be made at the time of the purchase for needed repairs.

6. Construction and Parts of the Refrigerator

a. Cabinets

The materials in cabinets of household refrigerators are generally made of sheet steel. The steel or wood frames are braced securely to maintain the shape of the cabinet and prevent air leakage through the seams and doors. Since steel of the cabinet and liner is a good conductor of heat, the refrigerator requires efficient insulation in the walls.

The finish of the cabinet may be of porcelain enamel or baked on synthetic enamel. Both are smooth and easy to clean. They do not ordinarily crack, chip or peel if given good care. Most of the cabinets are "bonderized" or especially treated, before the outside finish is applied. The bonderizing substance (iron phosphate or equal) is applied to the metal surface to protect it from rust.

The walls of some refrigerators are a synthetic enamel and the bottom is of porcelain enamel. Some manufacturers extend the porcelain enamel of the bottom several inches up the walls.

Regardless of the type of interior finish, it should be acid resistant, stainproof and impervious to moisture.

The liner of the cabinet is usually made of one piece of sheet steel. The finish of the interior is most satisfactory if it consists of two or three coats of porcelain enamel. This type finish is resistant to moisture and acid. It cleans easily. The other type of finish is baked or synthetic enamel. The corners of the liner are rounded for ease in cleaning. The shelf supports should be a part of the lining and not separate knobs to prevent possible air leakage.

The freezing unit (evaporator) is ordinarily made of a high heat conducting alloy.

b. Insulation

Insulation is vital to good refrigeration. It is placed between the outer walls of the cabinet and the liner. Insulation is a material that is a poor conductor of heat. Since more heat gets into the refrigerator when the door is closed than through frequent openings of the door, the efficiency of the refrigerator is largely dependent on the kind and amount of insulation that is used between the exterior walls and the liner. Good insulation material must be a poor conductor of heat, moisture resistant, non-destructible, and without odor. Fiber-glass, rock and glass wools are generally used for insulating modern refrigerators. At least one manufacturer uses a plastic material to insulate the refrigerator. The materials are made in batts or matted blankets. Sometimes a thin layer of wallboard is also placed next to the outer wall to decrease heat penetration. The insulation is sealed into the walls to prevent moisture absorption which may lower its efficiency.

In most refrigerators, the thickness of the insulation is three to four inches. With the plastic type insulation, only about two inches is used.

c. Doors

Doors have flush construction that allows the shelves to extend to the front of the food storage compartment or the doors are wedge-shaped. The breaker strip between outer shell and storage cabinet liner is made of plastic or other material to prevent the conduction of heat through the metal. On some refrigerators the door lining is plastic instead of enameled steel. A gasket of rubber or plastic is placed around the outer edge of the door to make it fit more closely to the cabinet and prevents the leakage of warm air.

Latches and hinges should be of good sturdy construction to hold the door securely. They should be chromium finished to prevent rusting. Doors may be hinged on either side. Right side hinges are most commonly used. The left side opening doors are slightly higher in cost but will provide for convenient use in some kitchens.

d. Shelves

Shelves are made of metal, plastic, and glass. The metal rods or bars should be of corrosion resistant material. They should be close enough together to hold small containers without tipping, but spaced wide enough for efficient air circulation.

The glass shelves are ribbed and may have an aluminum molding placed around the front edge to protect them. Adjustable shelves are used at different places to make the space more adaptable. A divided shelf increases the flexibility of the food chamber space. Some refrigerators have narrow recessed shelves in the door for storage of small items.

e. Refrigeration Mechanism

Most electric refrigerators have a completely enclosed condenser unit, "hermetically sealed." The motor and the compressor are within the same housing. This type does not require additional lubrication. This unit usually operates quietly.

The open type condenser unit will operate as well as the enclosed but it requires different care. The motor and compressor are separate and the compressor shaft is driven by a belt connected to the motor. Since it may be possible for the refrigerant to leak out around the piston and shaft, it is necessary to place a flexible packing around the shaft.

When the open type needs repair it may be easily serviced locally while the sealed unit has to be returned to the factory for repair.

f. Refrigerant

There are a number of chemical compounds used as refrigerants. (See section on "Principles of Refrigeration".) The most commonly used one in household refrigerators is Freon-12. It is efficient and safe because it is non-toxic, non-inflammable, non-explosive and has high latent heat - the hidden heat which is used in the process of changing ice from a solid to a liquid.

g. Temperature Controls

Refrigerators are equipped with manually controlled dials. The entire operation of the refrigerator - the starting, regulating and defrosting - is controlled by the dial control. This thermostat controls the temperature of the evaporator and storage compartment. It may be set at colder or warmer positions. Most models of refrigerators indicate a "normal" position setting which is usually satisfactory for average use. At times it may be necessary to select a warmer or colder setting.

The different types of refrigerators have different minimum and maximum settings which are set at the factory. The temperature setting for most vertical type evaporators is a maximum of 28 F. and a minimum of 5 F. to 10 F. At these temperatures the motor operates from 15 to 30 percent of the time.

h. Special Features

A refrigerator may have certain special features which add to the cost, though it may not affect the usual operation of the machine. There are "stripped" models that do not have all of these features but are as well built as the higher priced ones. The choice of the special features depends on the individual's needs and preferences.

i. Storage Bins

The dry storage bin or drawers under the food compartment gives space for storage of dry foods such as cereals. The moist cool storage bin located at the bottom of the refrigerated food storage compartment provides cool space for fresh fruits and some kinds of vegetables.

j. Meat Container

The meat container of glass, porcelain enamel, metal or plastic is located directly beneath the evaporator. It should slide out easily.

k. Shelves on Doors

The door shelf space is designed for special purposes - eggs, bottles, fruits, and vegetable bins.

l. Hydrators

Covered vegetable crispers or hydrators provide storage for fresh vegetables. If they are especially built to fit the refrigerator, the crisper uses space to an advantage.

m. Ice Trays

Ice trays are made of aluminum, plastic and rubber and are of different sizes. The cube releases vary in design. Those having special releases prevent damage to the cooling unit. The aluminum trays may be treated with wax to facilitate the removal of cubes. The rubber and plastic trays do not conduct heat as readily as metal. They are easily removed from the cooling unit and the cubes are released quickly.

n. Butter Compartments

Butter compartments are built sometimes into the wall or door of the refrigerator; the temperature inside is about 50 F.

o. Inside Light

Most refrigerators have an inside light which comes on when the door is opened. Some are equipped with germicidal lamps. The complete effectiveness in destroying harmful bacteria within the entire food storage compartment may depend upon the arrangement of the food.

p. Automatic Defrosters

Some refrigerators are equipped with a heating mechanism that defrosts the evaporator within a short period of time, 7 to 24 minutes. The timing device automatically resets itself, bringing the temperature back to normal.

These heating devices speed the defrosting and frozen foods remain frozen. The defrost water may drain into a tray outside the food compartment and is

evaporated, others have containers to hold the water inside the cabinet. Still other refrigerators have both a manual and automatic device for defrosting.

There are portable defrosters that operate with only a timing device. These are designed to automatically defrost the conventional U-evaporator refrigerator daily. Since the time settings are from 2½ to 5 hours and above, most frozen food stored in the evaporator will thaw each time the evaporator is defrosted.

7. Location

The place for the household refrigerator is in a convenient spot in the kitchen. For convenience it belongs at the mixing center or near the place where food is prepared. It is important to place it so the doors open next to a work surface. (Refrigerators are available with the door hinged on either side.)

For the best operation it should be placed away from the stove, radiators or hot air registers. Avoid placing the refrigerator where the sun will shine directly on it for long periods of time.

Allow space of at least 2½ inches between the back of the cabinet and the wall, 1 to 2 inches on either side and 8 to 12 inches of open space above the refrigerator. This provides good air circulation which carries away the heat from the refrigerator. Most refrigerators have an opening below the front apron for air circulation. If air circulation space is not allowed, mechanical ventilation should be provided.

The refrigerator should be level. Many refrigerators are equipped with mechanical levelers which provides for easy adjustment.

If possible, a separate electrical wall outlet should be near the refrigerator. For the protection of the refrigerator, never attach it to a drop light cord.

8. Cost

There are two factors to consider when buying a refrigerator, the initial cost and the operating cost.

a. Initial Cost

The purchase price of a refrigerator varies with the size and the number of cubic feet of frozen storage space, the type of insulation, finish, special features and kinds of hardware and the kind of financing used.

A porcelain enamel cabinet costs more than one of the same size finished with a synthetic enamel. Deluxe features, such as fancy containers, controlled humidity, automatic defroster, clocks, lights, water fountains, vegetable containers, all affect the initial cost. Whether or not the features are worth the extra cost depends on the individual's desires. The kind of financing used affects the cost of the refrigerator. Some of these methods may include dealer plans, bank loans and electric cooperative loans (S-5). Some of the interest rates or carrying charges are higher in cost than others.

b. Operating Cost

The cost of operating a refrigerator depends upon the care, the use and the prevailing rate of electricity per unit. Conditions vary in different homes. Some of the factors which affect the operating cost are:

(1) The number of times the door is opened.

(2) The temperature at which the food is kept.

(3) The temperature of the food placed in the food compartment.

(4) The amount of food and its arrangement in the compartment.

(5) The circulation of air around the cabinet.

(6) The room temperature.

(7) The exposure to the sun.

(8) Air leakage around the door gasket.

(9) The age of the refrigerator.

(10) Size - A larger refrigerator will cost only a little more to operate than a smaller one.

Tests show that refrigerators of six cubic feet use an average of about 30 kwh per month. This figure multiplied by the rate of current per unit gives the operating cost.

9. The Food Storage Compartment

The food storage compartment provides an average refrigerating temperature from 36 F. to 45 F. The non-frozen perishable foods are stored here. Some foods which must always be covered in a conventional refrigerator may be placed uncovered for a short period of time in the high humidity compartment.

General points for the use of the refrigerator.

a. Load the refrigerator according to the manufacturer's instructions. These instructions vary according to the make and model.

b. Store only clean fresh vegetables. Cover all foods unless protected with their own skins.

c. Keep all liquids, including milk, tightly covered. The moisture from the foods will evaporate and frost the evaporator.

d. Store meats, poultry, fish and milk in the coldest part of the refrigerator. Cover fresh meats loosely with a sheet of waxed paper. Store cheese in original container, waxed paper, film or foil.

e. Place cooked and leftover foods, canned goods and other miscellaneous items in the general food storage area. Do not put hot foods or dishes in the refrigerator, let the food and the dishes cool before storing.

f. Be certain that the shelves of the refrigerator are not overloaded, so that air can circulate freely over and around the foods.

10. Containers for Refrigerated Space

The containers may be of different kinds: hydrators of porcelain enamel with or without openings for ventilation, metal milk cans, opaque glass and plastic dishes or jars, bags of oiled silk or plastic moisture-vapor-resistant bags. They are used to

decrease the evaporation of moisture from the food and prevent the spread of odors. Square containers usually fit in the refrigerator more conveniently and conserve more space than others.

Large spreading crocks, oval dishes, shallow pans or other containers of irregular shape take up unnecessary space and require more refrigeration.

11. Evaporator Storage

Small amounts of frozen foods may be stored in the U-evaporator type of the conventional refrigerator for short periods of time; two to six days. In the horizontal evaporator store frozen foods for only two to three weeks. Store all frozen foods in their original containers.

There, small frozen food compartments are especially suited for short-time storage of pre-frozen foods and the preparation of frozen desserts. While food can be frozen in them it is recommended that it be stored only for short periods of time as the freezer temperature may be too high and such a practice may be expensive. Such equipment should be utilized on the basis of a rapid turnover and if so desired in conjunction with a home freezer, frozen food locker or purchased frozen foods.

Foods can be stored at Zero in the freezer compartment of the combination freezer-refrigerator for the same periods as in the home freezer. Foods to be frozen should be prepared and packaged as for use in a home freezer. Observe the same rule for the amount of food that can be frozen at one time; 1/10 of capacity as for the home freezer. It is recommended that not more than 6 to 8 pounds be frozen in a 24 hour period in a 2 cubic foot freezer compartment.

When freezing foods place the package flat against the floor or walls of the freezing compartment. After they are frozen solidly they may be placed in any convenient location. Left-over cooked foods may also be frozen and stored in the freezer, but for only a short period of time.

12. Refrigerator Food Preparation

The refrigerator may aid in planning for general meal preparation. For example, many kinds of doughs may be kept in the refrigerator and small amounts

baked as desired. This makes it possible to have fresh baked rolls, cookies and pastries frequently.

Several types of main dishes such as meat stews, casseroles of vegetables and meats may be prepared in advance and held ready for heating. If this is to be stored in the evaporator, wrap or package the food as for freezing.

a. Frozen Salads

The ingredients and the method of preparation produce different textured salads; follow a tested recipe for best results.

b. Frozen Desserts

Frozen desserts are classified according to the method of preparation such as ice creams, mousse, parfait, sherberts and ices. To have a smooth textured product with only small ice crystals, care must be taken in the preparation and the freezing processes.

13. General Hints on Frozen Desserts

a. Select a good recipe and follow the directions.

b. Chill bowls and spoons used for mixing frozen desserts. It is particularly important to have the bowl and beater chilled before beating the mixtures during the freezing process.

c. Mixtures should be chilled and all ingredients as near the same temperature as possible when folded together. This is especially true when whipped cream is one of the ingredients.

d. Cream should not be over-whipped. Whip until it will just pour off the spoon but will not hold a point. If cream is over-whipped, the texture will be poor, and the food may have a "buttery" taste. Use cream that is 28 to 30 percent butterfat. Heavy cream may be diluted with top milk. Very heavy creams do not give as much volume when whipped as lighter creams.

e. Beat egg whites until stiff and they hold a point, but not until they are dry. For greatest volume in whipped egg whites, remove eggs from the refrigerator 30 to 60 minutes before whipping. Beat in

one tablespoon of sugar for each egg white. To hold air fold in whipped cream and egg whites last.

f. Desserts have a better texture if frozen rapidly by turning the cold control to the lowest point. For fast freezing the tray should be placed on the lower shelf of the freezing unit or on the refrigerated shelf. For the greatest speed in freezing there must be close contact between the tray and the freezer shelf. To get a solid contact, have the bottom of the trays wet.

g. Thoroughly drain fruits for dessert before crushing, as excess moisture causes larger ice crystals. Crush or chop the fruits finely.

h. In making ice cream the most commonly used fillers or binders are eggs, cornstarch, flour, and gelatin. These serve to improve its texture and make it more resistant to melting.

i. Freshly frozen desserts have a smoother, finer texture than those which are stored several days before they are used. Cover the trays with wax paper or the tray cover, after the mixtures are frozen. This will help prevent the formation of frost and ice on the top of the food.

14. Refrigerator Care and Maintenance

For efficient and economical operation, the refrigerator requires good care, which includes maintenance when needed. Care of the refrigerator is easy if a few simple rules are followed regularly.

a. Exterior Cleaning

Clean the exterior surface; wash with a mild soap solution, follow with clear water rinse and dry with a soft cloth. The door may need cleaning "in between times". Never use harsh scratchy cleaning powders on any part of the refrigerator. Some manufacturers recommend cleaning the exterior surface by applying a cream wax or polish.

The polish cleans the surface and leaves a protective coating over the enamel. Use only products recommended by the manufacturer and follow the manufacturer's instructions for their use.

Clean the metal trim with warm soapy water and polish with a soft cloth. For occasional polishing or brightening use a fine silver polish.

b. Defrosting

When the cooling unit is coated with frost approximately 1/4 inch thick, or about the thickness of a lead pencil, it is time to defrost. Some refrigerators are equipped with a small indicator on the outside of the evaporator. As soon as the indicator is covered it is time to defrost. Always melt the frost, never use a sharp tool to dislodge it.

Remove all foods from the evaporator or cooling unit. Turn the temperature control to "defrost" or "off". Close the door. When frost is melted empty the drip tray to prevent an over-flow. Considerable time is required to defrost by this method. A quick way to defrost the refrigerator is by the "Hot Water Method." Remove the frozen food to one of the lower shelves, turn the temperature control to "off" or disconnect the refrigerator, place trays of warm water inside the evaporator. Some manufacturers do not recommend this method, so read the instructions before defrosting. As the warm water cools refill until the frost is loosened. Do not use boiling water.

A good job of defrosting requires the removal of every particle of ice and frost. As soon as the compartment is cleared of frost, clean with a solution of baking soda and water. The temperature of the cabinet is not necessarily increased by either method, as melting ice absorbs some of the heat.

The combination freezer and refrigerator requires less frequent defrosting than the conventional type. When defrosting this type do it as quickly as possible to prevent the thawing of the stored frozen food. The quick method is usually recommended to speed the defrosting process. Follow the manufacturer's instructions. The general procedure for cleaning is:

(1) Remove all food from the freezer before starting to defrost. Transfer frozen food to the home freezer, if there is one, or wrap in newspaper and place in the food storage compartment.

(2) Turn temperature control to "off" or "defrost."

(3) Remove the drain cap or plug and place a large container under the drain.

(4) Put a container of warm water in the freezing compartment. Leave the freezer door open until all the frost or ice is removed.

(5) Wash compartment with soda water solution (1 t. soda per qt.) rinse, dry and replace cap or plug.

(6) Turn the control back to the desired position.

(7) Empty the defrost container and clean it thoroughly.

(8) Allow freezer to cool and then replace the frozen foods.

c. Interior Cleaning

Remove all food, shelves, hydrators or other refrigerator containers. Clean all of the interior surface with a solution of 2 tablespoons of soda to one quart of water. Rinse with clear water and wipe dry.

Never use harsh scouring powders on the inside of the cabinet. Clean the door gasket with mild soapy water, rinse thoroughly to prevent deterioration of the gasket. Be certain to wipe between the gasket and the inner edge of the door; avoid soda water on the gasket. Rinse with clear water and dry thoroughly. Some manufacturers suggest dusting the gasket with talcum powder to prevent sticking and marring the cabinet.

Wash all of the food containers; drain pans and dishes used for collecting the excess moisture in the high humidity type refrigerator, and clean the drain with a brush.

16. Care of the Mechanism

Be certain to disconnect the refrigerator before cleaning the mechanism.

a. The hermetically sealed units require little care. No oiling or replacement of belts are needed. If it does not work, call a reliable serviceman.

b. The open type unit requires oil and belt adjustments. Clean the belt by wiping with a clean cloth. Oil according to the manufacturer's instructions.

c. The motor - Keep the motor free of dust. When it is excessively noisy call a serviceman.

d. Condenser - Clean the condenser occasionally. It is located either at the bottom or rear of the refrigerator. It is usually necessary to remove the outer back panel or the lower front panel to reach the condenser.

Lint and dust collect between the finned surfaces of the condenser and should be removed by using a stiff brush or a vacuum cleaner attachment.

e. Electrical connections - Check the cord and connections occasionally; see that the plug is securely in the outlet.

17. Refrigerator Storage

When the refrigerator is not in use, remove all food, disconnect, clean thoroughly and leave the door slightly open. If the mechanism is of the open type call a serviceman to close the valves. When the refrigerator is again used the valves will have to be opened and the refrigerant checked.

SECTION VI

HOME FREEZER

Introduction

Before a home freezer is purchased or built, many things should be considered because a freezer is a major investment. These include: (1) availability and adequacy of freezing space in the community; (2) money that can be invested, and (3) use which will be made of zero storage.

Consideration of the convenience of having the food on the farm instead of at a distance may justify the cost of building or buying and operating a home freezer. Some families will want a freezer to supplement the frozen food locker space in order to have foods stored at home, but will not want to freeze foods there. In some cases, better quality frozen products may be obtained at home, particularly if the local locker plants are not maintaining proper temperatures.

The main objectives in making a choice of a home freezer are economy, convenience, and dependability. Each of these is important. A careful consideration of the amount of frozen food space, the location of the space, the construction features, their operation costs, and the care problems is essential to the making of a wise choice.

1. Why Is Freezing of Foods Desirable?

a. Freezing gives an on-the-table product more nearly like fresh foods than any other method of food preservation.

b. It is possible to have a greater variety of out of season foods.

c. Time and energy in processing foods is saved.

d. A greater variety of food can provide for more tempting meals, which supply better health through better nutrition.

e. An emergency cupboard of choice foods is provided.

f. Meal preparation is made easier and quicker.

g. A family can have a variety of foods without waste, because leftovers can be frozen and stored for short periods.

2. How Does a Home Freezer Differ From a Refrigerator?

The refrigerator and the home freezer serve entirely different purposes. The freezer maintains temperatures of zero and below. The freezer is designed for preservation and storage of food over long periods, while a refrigerator keeps foods for shorter periods and holds them at temperatures above freezing (10 F. to 40 F.). It is necessary for many foods such as tomatoes, salad greens, milk, and other perishables to be stored at these temperatures since they cannot at this time be frozen satisfactorily.

3. Types of Freezers

In general design, home freezers fall into two classes - chest and upright. The chest freezer is low, with top opening lids; the upright is higher and opens at the front. If equally well built, the choice depends chiefly on the family's preference. The following are points that may enter into the decision.

a. Space Requirements

An upright freezer occupies less floor space than a horizontal one of the same capacity, but additional space must be allowed for the doors to swing open. Chest freezers, generally counter height, provide work space, which is often an advantage in the kitchen or utility room.

b. Cost

An upright freezer usually costs a little more than a chest model. For equally effective operation, more costly construction is required in the upright type.

A freezer that opens at the top has a natural advantage in maintaining low temperatures. When its lid is lifted, there is very little exchange of cold dry freezer air, with warm moist outside air, since cold air is heavier than warm. With an upright freezer, cold air tends to spill out when the door is opened and warm air comes in to take its place. This fact does not necessarily mean that operating costs are affected to an appreciable degree. Many upright freezers are equipped with some type of inner door. This aids in preventing against replacement of cold air with warm air. Also, in an upright freezer the heavier hinges and supports required for the front-opening door conduct more heat to the inside of the freezer.

c. Convenience

Whether one type of freezer is more convenient than the other is largely a matter of personal opinion. A carry-over of ideas gained from using a household refrigerator leads many persons to conclude that food stored in an upright freezer will be more easily accessible. However, problems in using refrigerators and freezers are quite different.

When a freezer is closely packed, there can be no reaching over tops of packages in front to get at those in the rear. To remove inner packages, those in front must be taken out and placed outside the freezer where temperature is relatively high. In top-opening freezers, packages taken out in order to reach the lower layers can be placed on those in another section. In this way, food will not warm up as much.

In a chest freezer, the hardest place to reach is the back part of the top and bottom shelves are the least accessible. When a family is considering different models, it is a good idea for the persons who will use the freezer most to try reaching various locations to find out which design is most convenient.

Some upright freezers have drawers instead of shelves so packages at the rear can be reached readily, and some chest freezers are equipped with baskets to make it easier to get packages at the bottom of the freezer. Although drawers and baskets are convenient, they use space otherwise available for storage, sometimes as much as a cubic foot. Also, baskets, if fully loaded, may be difficult to lift.

Irregularly shaped packages create more of a problem in an upright than in a chest freezer. They do not stack well and tend to slide out of an upright freezer when the door is opened. Particularly this is true if a door is frosted shut and has to be jarred loose.

Generally speaking, frost collects more rapidly in an upright than in a chest freezer. However, the upright is easier to defrost, especially when the shelves are refrigerated. The frost can be scraped to the front of the freezer where it can be easily taken out. In the chest freezer, frost falls to the bottom of the compartment as it is scraped from the walls or dividers and it is more difficult to remove. A few chest freezers have drains at the bottom so that water can conveniently be used in defrosting and cleaning.

COMPARISON OF FRONT AND TOP OPENING CABINETS.

Chest or Top Opening

1. Requires less defrosting.
2. Less leakage of air around door gaskets.
3. Less concentration of weight per sq. ft. of floor area.

1. Depth of storage makes it difficult to get at bottom packages.
2. Requires more floor space.

Vertical or Front Opening

1. Requires less floor space per cubic foot of volume.
2. Packages more accessible and selection easier.
3. Easier to defrost.

1. Packages fall out of some models when door is opened if cabinet is full.
2. More frequent defrosting is required.
3. Air space required between products and cabinet walls unless the wall is cooled directly by the refrigerant.
4. Air leakage around door gaskets somewhat more likely.
5. Greater concentration of weight to floor area.

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4. Separate Freezing Compartments

A freezer with a separate freezing compartment is a wise choice for the family that plans to freeze large amounts of food at home instead of using a locker service.

A freezing compartment is one separated from the rest of the freezer space by insulation or by a refrigerated

surface. This compartment is designed to be the coldest part of the freezer, so that food will freeze more quickly in it than elsewhere.

Equally important is the fact that the separate freezing compartment protects stored frozen food from excessive temperature changes while other food is being frozen. Temperature rise in stored food is less when the freezing load is kept completely separate than when freezing is done in the compartment in which the food is stored. 1/

5. Selection of a Home Freezer

Choosing the size of the freezer to meet the family needs is determined by considering the following:

a. Family Needs

The amount of freezer space needed will vary with the kind and quantities of food frozen and stored. This in turn varies with the source of food, the length of the growing season, and the habits of the owner. Five to six cubic feet of freezer space per person will meet the requirements of most families. If freezing is to supplement other methods of food preservation, or if a locker plant is to serve as the main means of storage, three cubic feet per person will usually be ample allowance for the home freezer. When most of the food for the family's year-round consumption is to be stored in the home freezer and there is much overlapping of storage times for the various foods, 10 cubic feet per person may not be excessive.

The space needed for storing food is not dependent on weight. Meats and fruit in syrup are heavy, whereas baked products are light weight for the space occupied. The capacity of freezers in cubic feet can be converted to the average number of pounds by multiplying by 35. (10 cubic feet freezers will hold approximately 350 lbs. of mixed frozen foods - meat, fruits, and vegetables.) If the growing season is short, more food has to be stored for longer periods, therefore, a larger chest is needed. The space required generally increases as families learn the many uses of the freezer.

Some families may prefer two medium sized freezers to one large one, and for some the largest size home freezer may not provide sufficient space. 2/

1/ Earl E. McCracken, Home Freezers Their Selection and Use, U. S. Department of Agriculture, Misc. Pub. #687

2/ Ibid

There are certain advantages in having two freezers. One can be used primarily for freezing and the other for storage. When the food supply gets low, all of the food can be stored in one freezer and the other disconnected. This will reduce operating costs. In case of failure of one mechanism, only part of the total frozen food supply has to be cared for. Although the initial cost is greater for two small or medium-sized freezers than for one large one providing an equal amount of space, however, the advantages may outweight the cost factor.

Some families may plan to use a home freezer to supplement their space in the locker plant. Then the medium or small sized freezer may be used for freezing small quantities of food and storing large enough amounts of food at home so that frequent trips to the locker will not be necessary.

The table on the following page will help as a guide for determining the type of freezing needs of farm families.

	LOCKER SPACE	HOME FREEZER	COMBINED USE OF LOCKER SPACE AND HOME FREEZER
1. Cost of Equipment	None, just rent.	Large investment.	Rent, plus smaller cost of smaller freezer.
2. Convenience	Varies with distance from plant, but never as great as with home freezer. Closed Sundays and holidays.	Can freeze foods when at best and get them out when needed. Always open.	Can freeze small amounts at home, taking only large amounts to locker plant. Should keep 1- 2 weeks supply in home freezer.
3. Processing	Processing and wrapping may not be done as carefully as at home, though better equipment available for handling meats. Usually costs more than to do it at home.	When processing and wrapping done at home, usually more careful, may be cheaper.	All may be done at home, or it may be wise to have meat done at plant.
4. Freezing Capacity	Large amounts can be frozen at one time. Whole carcass can be frozen.	Will not freeze large amounts at one time.	Would use space in locker plant for freezing large amounts, including whole carcass.
5. Control of Food	Many patrons of locker plants report losses through failure to use food.	Allows one to keep an accurate account of what is on hand. Less losses.	Food stored at home, same advantages as home freezer; food at locker plant, disadvantages of locker space, store a large enough supply to take care of emergencies.

		LOCKER SPACE	HOME FREEZER	COMBINED USE OF LOCKER SPACE AND HOME FREEZER
6.	LOSSES THROUGH CURRENT INTERUPTIONS AND FREEZER BREAKDOWN	LITTLE DANGER AS LOCKER PLANTS HAVE "STAND BY"	DANGER FROM THIS DEPENDS ON RELIABILITY OF ELECTRIC SERVICE AND FREEDOM FROM STORMS. MAY HAVE FOOD INSURANCE, SHOULD HAVE GOOD REPAIR SERVICE.	IN CASE OF PROLONGED OUTAGES, FOOD FROM HOME MIGHT BE TAKEN TO LOCKER PLANT.
7.	FREEZING OF LEFT-OVERS	NOT FEASIBLE TO FREEZE LEFT-OVERS, DUE TO DISTANCE FROM PLANT AND AMOUNT OF FOOD INVOLVED.	WITH FREEZER IN HOME, MANY LEFT-OVERS CAN BE FROZEN, ALLOWING MORE VARIED MEALS, GREATER ECONOMY.	HAS ADVANTAGES OF HOME FREEZER.
8.	COST OF SERVICE	COST IS SET, CAN BE BUDGETED, USUALLY LESS THAN HOME FREEZING.	COST VARIABLE, DEPENDS ON CARE USED IN OPERATING. IF FREEZER IS OPENED FREQUENTLY, COST INCREASES.	FOR SAME NUMBER OF CUBIC FEET, COST OF COMBINATION PLAN FALLS BETWEEN OTHER TWO, BUT OFFERS ADVANTAGES OF BOTH.
9.	EQUITY	NOTHING BUT LOCKER RECEIPTS TO SHOW FOR MONEY SPENT, EXCEPT CO-OP. LOCKER PLANTS.	HAVE VALUABLE PIECE OF EQUIPMENT WHICH CAN BE MOVED OR SOLD.	HAVE EQUITY IN SMALLER FREEZER.
10.	SPACE FOR EQUIPMENT	FREEZING AND STORAGE TAKEN CARE OF OUTSIDE THE HOME.	SPACE NOT ALWAYS AVAILABLE FOR FREEZER IN FREEZER IN FAVORABLE LOCATION.	USUALLY CAN FIND A GOOD LOCATION FOR A SMALL FREEZER, WITH FREEZING AND SOME STORAGE TAKEN CARE OF AT PLANT.

From these comparisons it is apparent that owning a home freezer offers many advantages in convenience over the exclusive renting of locker space. On the other hand, renting a locker space may prove more economical. The best solution is probably a combination of the two methods; using the locker plant to quick freeze and to store foods of which there are quantities, but relying on a medium-sized home freezer for week to week storage of goods from the locker room; and for freezing of left-overs and small amounts of food. If the cost of freezing foods is the prime consideration, no doubt the decision will be to rely on the locker space exclusively, providing it is not too far away.

b. Space Limitations

The floor space and location chosen for a freezer may limit the size or determine whether a chest or an upright freezer is used. Careful measurements of width, depth, and height need to be considered if space is limited. However, if possible the room space should not limit the size of the freezer chosen. Physical limitations such as doors, stairways, and the strength of the floor support, need to be checked.

c. Convenience of Location

Convenience of location is a point for the homemaker to consider but may not be of major importance. Ordinarily, a freezer needs to be opened only once or twice a day. From the standpoint of use, the kitchen or utility room may be the best place, but in many homes these rooms have no space for additional large equipment. Moreover, a kitchen or utility room is likely to be warm, and the operation of the freezer will only add more heat.

d. Cost

It is estimated that the initial cost of a home freezer will be from $30.00 to $35.00 per cubic foot. However, it will depend upon the size and model selected, as the size is increased the price per cubic foot decreases. The initail cost may be considered relatively high, but serious consideration should be given to how long they are used and the value of the foods stored in the freezer. By prorating the cost over a period of ten to twenty years the annual cost is not great.

e. Reliability of a Manufacturer and Available Repair Service

A freezer made by a reliable, well-established refrigeration manufacturer, and sold by a dependable local dealer

is the best assurance of continued operation. The availability of repair parts and services is important, since considerable money is invested in a freezer and the food storage in it. A failure in operation may result in loss of food. The manufacturer or the dealer should guarantee the entire freezer to give satisfactory service for one year, and the refrigeration system for five years. Read the warranty and guarantee. Ask if food storage insurance is available, either free or for a small sum. This insures against loss of food on the freezer. Some desirable features of home freezers can not be judged by the buyer so that manufacturers statements must be depended upon.

6. Locating the Freezer

The ideal location, from an operation standpoint, is a cool, dry, well-ventilated place, with adequate space for air circulation around the compressor. The higher the room temperature, the more the motor must run to maintain the freezer temperature. This results in higher cost of operation and more wear and tear on the mechanism. However, it is bad practice to put the freezer where the temperature falls below 40 F. unless it is specifically designed to operate at low temperatures, and so stated by the manufacturer. At lowest temperature, the freezer mechanism may fail to function properly.

It is best to have dry air surrounding the cabinet. Dampness may damage not only exposed metal surfaces but also the motor, motor supports, and springs. In a damp place, moisture is likely to condense on the freezer's outer walls and may even drip to form pools of water on the floor. 3/

The freezer should not be placed in direct sun light. Circulation of air is needed to carry off the heat of freezer operation. Therefore, a freezer should not be placed tightly into a niche with walls on three sides. Several inches on all sides of the freezer will allow free movement of air. 4/

Locations commonly used include the following:

a. Kitchen

A small frozen food cabinet placed in the kitchen is ideal for convenience, and will probably result in faster food turnover. If the room temperature is high, the operating cost may be increased.

3/ and 4/ Ibid

b. Utility Room

If there is adequate space, a utility room located near the kitchen will usually be the most convenient place for the freezer.

c. Basement

A basement generally offers more in the way of space than the kitchen or utility room. Often, it has the lowest temperature in the house. Of there is a furnace, this may not be true in winter.

A disadvantage of having the freezer in the basement is the inconvenience of carrying the food up and down stairs. If the basement is the chosen location, stairs that are well-lighted and safe are essential as an accident-prevention measure. A basement that is very damp, or one that is sometimes flooded, is not a good selection. It is difficult to repair a motor that has been flooded, and if water gets into storage compartments, food is likely to be spoiled.

d. Garage

A garage attached to the house may be a satisfactory place for the freezer. It is fairly convenient and ordinarily the temperature will not fall low enough to interfere with freezer operation.

e. Porch

In some parts of the country a shaded porch may be suitable, or a shed or other outbuilding may be used, provided it meets the general requirements as to dryness and temperature.

Before the freezer is selected and location decided on, it is best to take measurements, so that the freezer will fit the space and that it will go through doors and narrow passageways, around corners, and up or down stairs if necessary. Getting a freezer into the house is sometimes a special problem.

Another requirement for the freezer location is a floor strong enough to support the weight. Freezers are heavy, even when empty, and a full load of food may add several hundred pounds.

Remember, upright freezers put more weight per square foot on a floor than do horizontal ones of the same capacity. A solidly built floor will reduce the noise of freezer operation and the possibility of unnecessary wear on its mechanism.

7. Construction Features

Some characteristics of construction are vital to the efficient operation of a freezer, others are desirable. The following points should be considered:

a. Exterior

Outer walls are generally of metal such as aluminum, stainless steel, and steel baked enamel finish. Baked enamel cabinets are commonly white to reflect some of the heat rays and to match standard kitchen equipment. A point for the buyer to check is whether enameled steel has been treated, "bonderized", to resist corrosion or rust in case the coating is scratched through or chipped. The finish should be easy to clean and rustproof.

b. Interior

The liners of freezer compartments are steel, aluminum and stainless steel. The finish may be baked enamel, anodized aluminum, or porcelain enamel. Rounded corners and smooth seams makes cleaning easier. Material should be rustproof and bonderized.

c. Insulation

In general, the thicker the insulation the more economical the operation of the freezer. Increasing the thickness cuts down the food storage space as the exterior dimensions are limited by the physical sizes of doors and stairways. Most manufacturers use three to six inches of insulating material. If the compressor is below the freezer, the amount of insulation on the bottom should be at least as much as in the walls, because the heat from the compressor may make the bottom of the cabinet too warm for the storage of frozen foods.

d. Vapor Seal

The insulation must be vapor sealed on the warm side (outer) to prevent moisture in the air from entering the insulation. If it becomes wet or full of ice the insulating qualities are permanently lost. Information on this may be obtained from the dealer or manufacturer. Improper or no vapor barrier increases operation costs.

e. Door Seal

Flush or recessed doors have gaskets to prevent passage of water vapor into the freezer. Double or single gaskets of flexible rubber or plastic are used. The double

seal is more effective than the narrow single seal in keeping heat out of the freezer. However, any water vapor that passes the first gasket may be deposited between the two gaskets in the form of water and possibly freeze later; this makes it difficult to open the door of the freezer. In contrast, the water vapor that gets by a single seal continues into the interior and is deposited there as frost. 5/

The wide single seal, if properly constructed, reduces both heat leakage and accumulation of moisture or ice between the surfaces. If a counter balanced lid is used a tension latch is necessary to provide a good seal.

f. Lid

Counter balanced hinges or a safety device to hold the door open are essential for safety. A tension latch is necessary with a counter balanced lid. Hinged lids are easier to handle than lift lids.

g. Hardware

On a home freezer, hardware needs to be strong to stand up under the use and conditions to which it is subjected. Since the outside of some freezers sweat, all of the hardware should be rust-resistant. An upright freezer needs heavy hinges to keep the door from sagging.

h. Toe Space

The chest type freezer is more convenient if toe space is allowed for convenience in work when placing or removing food from the freezer.

i. Interior Lights

In a freezer, a light is a desirable feature, particularly, if the freezer is located in a poorly lighted place.

j. Space Arrangement

Food should be easily accessible. Depth and width affect availability in both chest or upright models. Openings should be large enough to allow for organizing packages. Baskets, trays, and spacers should be adjustable and removable, and easy to handle when loaded.

k. Thermometer

Thermometers and temperature indicators are built into some cabinets or fastened to a basket or divider to show

the internal temperature. A reliable one may be added by the user if none is furnished.

1. Warning Devices

Lights or warning bells are supplied with most freezers to indicate when temperatures are too high or when the freezer is not operating. A freezer alarm may be purchased and installed separately.

Even though the owner is careful to check on freezer operation each day, there is need for a signal to give warning when something is wrong. This is necessary because the temperature rise may be very rapid in some parts of the freezer. The alarm should give the warning signal before the warmest package in a partly loaded freezer reaches 15 F. This is necessary because some of the food may reach such a high temperature that it would be unwise to refreeze it.

If an alarm is installed after the freezer is purchased, the best place for the sensitive bulb that controls it is against a back liner level with the top.

Other desirable features in an alarm system include:

(1) A signal that is audible rather than visible and loud enough to be heard readily.

(2) An alarm that signals either when the circuit is broken or when the temperature rises above normal operating temperature.

(3) Connections that interfere as little as possible with the gasket seals.

(4) A manual means for turning off the signal and for testing the alarm system.

Whether built into the freezer or installed later, the alarm system will need occasional checking. This can be done by warming the sensitive bulb, either taking it out or by other methods to see whether it is working.

The battery operating an alarm system requires checking and replacing occasionally.

8. Mechanism of the Home Freezer

The mechanism includes a compressor, condenser, evaporator, expansion device, and controls. For full details, refer to Section IV, Principles of Refrigeration. The following specifications apply to the home freezer.

a. Compressor

The two kinds of units used in freezers are open type and hermetically sealed. The latter is more compact and quieter in operation and needs no oiling. Hermetically sealed units must be returned to the factory for repairs. There is no danger of refrigerant leakage.

The open type unit costs more than the hermetically sealed and operates more efficiently but the belt may break and cause an operating failure. However, repairs can generally be made by local servicemen. For either type, there should be an overload cut out switch on the motor. The size of motor varies with design and the manufacturer's opinion of how a freezer will be used. The storage of frozen food requires less power than the freezing so that low power units are designed for storage cabinets only.

b. Condenser

The condenser is the mechanism in which the heat absorbed by the refrigerant is removed to outside air. It generally consists of coils with heat-dissipating fins and may be fan-cooled or of the gravity type. In a fan-cooled condenser, a motor-driven fan forces air through the coils to cool them. A gravity-type condenser is set at an angle so that the natural flow of air can cool the coils. Compressor units with gravity-type condenser usually cost slightly more to operate than those with a fan-cooled condenser.

The condenser coils in some freezers fasten to the outside shell of the cabinet and the heat is dissipated through the metal shell. It is claimed that this will retard condensation of moisture on the outside of the cabinet.

c. Evaporator

The evaporator is made up of coils through which the refrigerant circulates. The coils may be in the form of tubing attached to the inside liners or they may be stamped into plates that are used as liners, dividers, or shelves. The area of the evaporator surface is one of the factors that determine how efficiently a freezer will operate.

All other factors being equal, the freezer with the largest evaporator surface is the one to be preferred. A small evaporator must have a much lower temperature than a large one to produce a given freezer-air temperature, and requires more extensive compressor operation. Also, the lower the evaporator temperature, the greater tendency of the food in the freezer to dry out, because there is greater temperature difference of plate and food packages. Automatic devices for controlling the evaporator temperature can generally be set by the user.

9. Cost of Operating a Freezer

Operating costs vary depending on such factors as size and design of the freezer capacity of the compressor, freezer location, and the local electric rate. To freeze a pound of food and lower its temperature to 0 degrees F. for storage, about 0.1 kilowatt-hour of electrical energy is required. Energy for maintaining zero temperature in a freezer for 24 hours can be estimated roughly as follows:

Size of Freezer	Energy per cubic foot (kwh/day)
6 cubic feet	0.35
12 cubic feet	.30
18 cubic feet	.25

In the following example, the Department of Agriculture computes a year's cost for home freezing, exclusive of the cost of the food. The example is based on the use of a $400.00, 12 cubic-foot freezer (360 pound capacity), with three conditions: (1) no turn-over of frozen food (2) with turn-overs of 50 percent; (3) with turn-overs of 150 percent. Since all costs, except those for packaging and freezing food, remain the same regardless of the quantity of food in the freezer, the higher the rate of turnover, the lower the cost per pound of frozen food, as shown:

Expenditure Item: 6/			
Amortization charges (3 percent interest, 10 years life expectancy)	360 lb. of food $46.89	540 lb. of food $46.89	900 lb. of food $46.89
Repairs (2 percent of purchase price)	8.00	8.00	8.00
Electricity			
For freezing food (0.1 kw.-hr. per lb. at 3 cents per kw.-hr.)	1.08	1.62	2.70
For maintaining 0 F. (0.3 kw.-hr. per cu. ft. per 24 hr. at 3 cents per kw.-hr.)	39.42	39.42	39.42
Packaging (2 cents per lb.)	7.20	10.80	18.00
	$102.59	$106.73	$115.01
Cost per pound of food	.28	.20	.13

Locker-plant costs, for comparison with home freezer costs, can easily be computed from the plant's rates for locker rental and charges for the services provided.

10. Installation

Although the smaller freezers (those with 1/8, 1/6 and 1/4 hp. motor) can be used on a 15 ampere circuit, the larger freezers with 1/2 hp. motors must be on a 20 ampere circuit. It is best to have a separate circuit for all freezers so that it can be properly fused. This is also advisable so that the use of other electrical equipment will not interfere with the proper storage temperature of large quantities of frozen food. Some large compressors require 220 volt service.

a. Temperature Control

Although the manufacturer's directions should be followed for controlling the temperatures, some controls are to be set by the user for storage or freezing loads. Other freezer controls are set by the manufacturer and cannot be set by the user.

The accepted storage temperature for proper storage of frozen foods is zero or below. Since there is usually

6/ Ibid

some temperature difference within the cabinet the warmest place should be zero, which will bring the colder portions below zero. If possible, it is well to set the temperatures lower before placing a freezing load in the freezer. This brings the temperature of stored food down so the warm food does not warm it above zero.

b. Freezing

The quantity of food that can be frozen successfully at one time depends on the kind of food, size and kind of packages, and design of the freezer. When food freezes too slowly, loss of quality or even spoilage may result. However, if freezing is completed within 24 hours, it is difficult for even an experienced judge to detect differences in palatability of foods frozen at different rates. 7/

The manufacturer's directions usually recommend a maximum load for a particular freezer and state where the load should be placed. It is generally advisable to limit the freezing load to one-fifteenth or, at most, one-tenth of the total capacity of the freezer. This is usually the maximum quantity of food that can be frozen and reduced to storage temperature in 24 hours. 8/ Larger loads will raise the temperature in the cabinet, which results in temperature fluctuation of the food already frozen.

Packages should be placed about an inch apart on the refrigerated surface or in contact with the walls to allow for the most air circulation. Stacking food to be frozen should be avoided. The kind of food to be frozen has some effect on the quantity of food which should be frozen at one time. Heavy compact foods, such as a rolled rib roast, freeze more slowly than loose, light weight ones like broccoli. Therefore, freeze less total weight of a compact food at one time.

c. Storage

A tidy arrangement of packages will prevent damage to packaging and make it easier to find the desired package. A record (a running inventory) of food placed in the freezer and removed will help owners make better use of food stored.

7/ and 8/ Ibid

Some foods should be stored at the coldest location because they require a lower temperature to freeze and keep properly. These are fatty and cooked fish, ground meats, ready cooked products and foods packed in heavy syrup.

11. Use of the Home Freezer

If food is frozen at home, more space is needed than if the locker plant services are used for the processing and freezing. This means many of the larger size home freezers.

A schedule and plan for organizing the food in the freezer is helpful in its efficient use. It is convenient to keep an inventory sheet near the freezer to record both the food that is stored and removed. By the use of the flexible dividers and baskets, food may be stored according to its kind and use.

Most freezers are designed to produce some flexibility in its use by the cold control - a small dial which shows the different degrees of temperature. The dial may be set to the temperature required for freezing or storage. The markings on the dial vary with the make of freezer. Follow the manufacturers instructions as to the regulation of the temperature.

12. Care of the Home Freezer

a. Internal Defrosting

Excessive frost and ice on the freezer liners and dividers mean that the compressor is having to do extra work. The thicker the deposit the more the compressor has run to maintain the required temperature. When frost is $\frac{1}{4}$ inch thick it should be scraped off with a special broad spatula or a dull edged tool. The frozen food can be moved to one side and then frost can be collected on cardboard or cloth and removed easily. When frost collects on drawers of an upright freezer they should be removed in order to scrape it from the wall.

b. Complete Defrosting and Washing

Complete defrosting is necessary only about once a year, when ice accumulates on a large part of the liner or shelves or when excessive foods have been spilled. The following is a guide for defrosting and washing the freezer:

(1) Remove food into a compact pile.

(2) Cover with a heavy blanket or newspaper.

(3) Turn off freezer.

(4) Scrape off frost.

(5) Allow freezer to warm up - this may be speeded by using a fan to blow air into the cabinet or cold air out.

(6) After the ice and frost are melted, wash the freezer liner with an alkaline solution (1 tablespoon baking soda to 1 quart water) or warm water and detergent (never a soap or caustic solution).

(7) Rinse with clear warm water and remove from bottom of freezer.

(8) Allow to dry. A fan may be used to quicken drying.

(9) Turn on freezer. Allow freezer to chill before replacing food.

(10) Take an inventory before returning the packages to the freezer. It is a good time to bring older packages to the front or top and mark them for first use. Remember that frozen foods, particularly cooked meats, do deteriorate if they are not used in a reasonable length of time.

(11) Wash the outside of the freezer with soapy water, rinse and dry thoroughly.

c. Oiling

At time of installation, it is advisable to check the method of oiling with the servicemen. For oiling the open compressor unit, be certain to follow the manufacturer's instructions.

Lubricate the fan motor, according to the manufacturers instructions. Usually this needs to be done once a year with the recommended type of lubricant.

d. Cleaning the Condenser

A condenser operates more efficiently when clean. Always disconnect the freezer before cleaning. The dust and

lint that collects on the condenser coils should be thoroughly removed by whisk broom or dusting tool attachment on a vacuum cleaner. Follow manufacturer's instructions for reaching the coils.

e. Care When Freezer Is Not In Use

(1) Disconnect.

(2) Defrost.

(3) Clean and leave door or lid slightly open to permit circulation of air and to prevent undesirable odors.

(4) If the freezer has an open type compressor, a service man will need to pump the refrigerant into the tank and close the valve.

(5) To put in use again, clean the condenser and oil the fan motor. Call service man to open the refrigerant valve if not of the closed type compressor unit.

13. What To Do In Case of Non-Operation

When a freezer fails to operate, the difficulty may be in the mechanism or in the electric circuit. The first thing to do is to look for clues as to what may be wrong. Remember, if the freezer motor is not operating, first be sure the plug is properly in the outlet, the connection may have been broken even though the plug has not fallen out. Then try a lamp or other appliance in the outlet. If it doesn't work, look for the fuse trouble. If the fuse is all right, there must be trouble farther back in the line. If there is no electric current at the main switch, it means that the power is out.

a. Mechanical Outage

With an open-type compressor unit, if the motor is running, but a high freezer temperature indicates that no refrigeration is taking place, the belt may be broken. Putting on a new one will remedy the trouble.

If the belt is still in place but not moving, it may need tightening. This can usually be done by sliding the motor on its base. However, it is often best to replace the belt with a new one since it may have been weakened by the rotation of the motor pulley against it. The worn belt can be kept temporarily for use in emergencies.

If tightening the bolt or putting on a new one does not remedy the difficulty, the compressor valves may be stuck. For this and any other causes of non-refrigeration in an open-type unit, a serviceman will be needed.

When a hermetically sealed unit is running and no refrigeration is taking place, call a serviceman.

b. Power Outage

When a power failure occurs, the cabinet should not be opened. Try to find out how long the outage is likely to continue. If only a few hours, no precautions need to be taken. If longer, the best procedure is to use dry ice.

One 50-pound cake will be enough to protect a freezer up to 36 hours. Saw or chop the dry ice into pieces proportional to the sizes of the storage compartments. Never handle dry ice with bare hands, it may cause burns. Every effort should be made by the power supplier to assure the availability of dry ice in the community.

If any stored food is in the freezing compartment, move it quickly into the storage compartment before putting in the dry ice. Place the dry ice on boards on top of the packages, not directly on the packages. Do not open the freezer again until it is necessary to put in more dry ice or until the freezer has been in operation for a few hours. If dry ice is used, covering the freezer with blankets helps to retard rise of temperature. Blankets alone have little or no effect. 9/

It may be possible to store the food in a locker plant, if the power outage is to be prolonged.

9/ Ibid

WALK-IN HOME REFRIGERATORS

Introduction

A multi-purpose farm refrigerator can be used to improve home living and add to the farm income. Refrigeration space of three different temperatures can be combined to suit the family's needs. These temperatures are for the freezer, zero or below; for the chill room 34-38 F., and for the household refrigerator 36-45 F. Any one of these or a combination can be called a walk-in or reach-in refrigerator.

A controlled chilling room can serve to chill and age meats at home before freezing, to store garden produce before marketing, and to hold food for family preservation at top quality. By using a chilling room, higher quality poultry, meat, eggs, fruits, and vegetables may be marketed. Butchering can be done at home when animals are at their prime instead of waiting until cold weather.

To determine whether a walk-in farm refrigerator is needed the following questions should have careful thought.

a. Is more refrigerated space needed to handle the family food supply?

b. Can the farm income be increased by producing higher quality foods?

c. Is a locker plant near enough to make efficient use of its facilities?

d. Is competent refrigeration maintenance and repair service available locally?

e. Is the location of the family comparatively permanent? Is the home owned or rented?

In general, a walk-in refrigerator is a two-compartment unit, chilling room and freezer. The chilling room is designed to maintain 34-38 F. temperature and is used for chilling meats, cream, eggs, milk, fruits, and

vegetables and for short time storage of garden produce. The size of this room may vary from about 100 to 600 cubic feet or even larger. The freezer or frozen food compartments are designed to maintain zero or below temperatures for the freezing and storing of foods. This section may be a chest, a reach-in or walk-in compartment. The size varies from about 25 to 100 cubic feet or larger. A third compartment, or household refrigeration section, is sometimes provided if the walk-in is located near the kitchen.

If the decision is in favor of a walk-in farm refrigerator after considering space needs and freezer requirements the family has to decide whether a commercially built or a home-built type will serve them best. The following questions will help to determine availability of commercially built equipment.

a. Is there a local source of commercially-built equipment?

b. Is maintenance service available?

c. Will the commercial product meet the family needs?

d. Can the equipment be moved into, constructed, or erected in the chosen location?

Complete information on building a walk-in is needed and should be obtained from a reliable source, such as a state agricultural college. After studying the plans, select one which meets the family needs. Determine the availability and the cost of materials and labor. These questions are important and need to be answered:

a. Can all parts be purchased?

b. Is a good carpenter available?

c. Is an experienced refrigeration man available?

Considerable time and money is spent in constructing a walk-in. This makes it important to have the assistance of someone with experience and knowledge of refrigeration equipment as well as carpentry to build an efficient walk-in.

1. Determining the Size of a Walk-In

In order to determine the walk-in that will best meet farm requirements the following points need consideration:

(1) Size of the family

(2) Family's food requirements

(3) Uses to be made of the freezer and chilling rooms

(4) The amount and kind of food to be frozen and stored.

Home construction of a walk-in unit is practical only if the prospective builder has the ability and experience to study the principles and details of proper design and construction. There are many hazards in building a homemade unit. One example is that not only a proven insulation of proper thickness be used and all outside surfaces must be absolutely vapor sealed. The necessity for a positive vapor seal on the outer surface on the insulation is only one of the considerations in planning and constructing a walk-in unit.

a. Size of the Family

The future as well as the present family will be one factor affecting refrigeration space needed. Another is the number of persons outside of the family and guests who are served regularly. In determining the frozen food space required, allow five or six cubic feet per person, which is the accepted average if fruit and vegetables are stored.

b. Family Food Requirements

Food habits vary with individual families and the available sources of food. Experience shows that with refrigerated space, food habits improve and additional space is required.

c. Amount and Kind of Food

The amount of food raised on the farm, vegetables, fruits, animals and poultry, affect the space needed in the chilling room and freezer. To estimate the

needed capacity for the chill room, allow about 3 cubic feet of space for each bushel which takes care of the container, the aisles, and the unavoidable waste of food in packing for large storage. In a smaller space (most farm refrigerators) 2½ cubic feet per bushel is more often accepted as the figure for estimated capacity. For zero storage of food space, it is estimated that one cubic foot stores about 35 pounds of vegetables, 30 pounds meats, 25 pounds or less of cooked foods. Usually 30 pounds is an average for an assortment of frozen meats, vegetables, and fruits. The interior design of the shelves, racks and coils affect the usability of storage space.

(To estimate the maximum loading for any freezer per 24-hour period, multiply the total effective square feet of loading surface in the freezing area by 12 pounds for meat; less for fruits and vegetables.) These are average figures since there would be a variance, depending upon such conditions as the nature and temperature of the freezing medium, the nature of products to be frozen, thickness of the product, and the insulating effect of various packaging materials. Manufacturers' directions for commercially built freezers usually recommend a maximum load for a particular freezer and state where the load should be placed. It is generally advisable to limit the freezing load to 1/15 or at most 1/10 of the total cubic foot capacity of the freezer. As an example of the space required for different kinds of foods the following table shows the estimated amounts for a family of four. From these tables the size of the freezer may be determined for an individual family.

ESTIMATED NUMBER OF PACKAGES OF FRUIT REQUIRED YEARLY
FOR A FAMILY OF FOUR
(Based on 1 pint or 1 pound packages)

Sliced Apples (Pie)	5 packages
Applesauce	20 packages
Cider	25 packages
Baked Apples	25 pounds
Cherries, pitted and sugared	20 packages
Peaches	25 packages
Pineapple	10 packages
Strawberries (fresh)	25 packages
(jam)	20 packages
(all varieties)	15 packages
Blueberries	10 packages
Fruit Cocktail	15 packages
Muskmelon	10 packages
Grapefruit	10 packages
Total	235 packages

ESTIMATED NUMBER OF PACKAGES OF VEGETABLES REQUIRED YEARLY BY A FAMILY OF FOUR

(Based on 1 pint or 1 pound packages)

Rhubarb	15 packages
Asparagus	25 packages
Peas	25 packages
Snap Beans	20 packages
Sweet Corn, cut off	20 packages
6 ears each	5 packages
Lima Beans	25 packages
Beet Greens	5 packages
Swiss Chard	5 packages
Edible Soybeans	5 packages
Green Peppers	10 packages
Broccoli	10 packages
Spinach	15 packages
Cauliflower	10 packages
Brussel Sprouts	10 packages
Carrots	5 packages
Beets	5 packages
Pumpkin (for pie)	5 packages
Squash	5 packages
Mushrooms	5 packages
Total	230 packages

MAXIMUM AMOUNTS OF MISCELLANEOUS FOODS TO BE HELD IN FREEZER AT ONE TIME

Butter	6 pounds
Lard	5 pounds
Eggs	10 packages
Cream	10 pints
Nuts	5 pounds
Cheese	5 pounds
Candies	2 pounds
Coconut	2 pounds
Ice Cream (3 gal.)	20 pounds
Pies (5) equal	10 pounds
Cakes (2) equal	6 pounds
Home Baked Rolls, 2 doz.	3 pounds
Home Baked Bread	6 pounds
Baked Beans	3 pounds
Spaghetti and Meat Balls	3 pounds
Other Ready-cooked Foods (soup, stews, etc.)	10 pounds
Total	106 pounds

Because of the vast differences from state to state and from family to family in the kinds of meat preferred, no table on meats is given. It is suggested that 150 pounds per person be frozen, or 600 pounds for the family of four being considered in the tables. The word "meat" as used includes poultry and fish as well.

The total amounts of food suggested are as follows:

Fruits	235 pounds
Vegetables	230 pounds
Miscellaneous Foods	106 pounds
Meats	600 pounds
Total	1,171 pounds

To store 1,171 pounds requires approximately 40 cubic feet (at 30 pounds per cu. ft.). However, a minimum of 50 feet is recommended for this farm family. If the family plans to sell frozen foods, both the amount planted and frozen, and the size of the freezer, will need to be increased.

The space available for farm refrigerator may limit the size. The space required for an average size walk-in refrigerator is about 8' x 10' x 8'.

2. Selecting the Location For the Farm Refrigerator

The location for the walk-in needs consideration before a final plan is selected. The available location may limit or determine the dimensions of the walk-in.

a. A desirable location should have these characteristics:

A dry, cool space with small temperature fluctuations.

Direct sunlight is to be avoided.

(1) Surrounding temperatures above freezing.

(2) A strong foundation or possible space to construct one.

(3) Easily accessible from the kitchen.

(4) Clean, sanitary surroundings.

(5) Well-ventilated air circulation around the refrigeration unit.

b. Some probable locations include:

(1) Basement.

(2) Porch.

(3) Garage

(4) End of kitchen or separate addition.

A basement has little temperature fluctuations, but may not be handy to the kitchen. However, if there is a possibility that walk-ins can not be moved into basements, it is well to know that many commercial walk-ins may be purchased in sections. The construction in the basement is possibly the cheapest and heating the cold room during severe weather is not necessary. Porches are often near kitchens but need to be checked to determine if the extra weight can be supported.

Garages may be dry and clean and located conveniently to the kitchen, but may need to be heated in very cold weather. Temperatures often fluctuate too much in garages.

3. Cost of Building

The cost of building will depend on a variety of items which need to be thought through:

a. Location Selected

Four walls are needed for a walk-in, but sometimes one or two walls of a building may be used and insulation added to the existing walls. Usually, the supporting foundation needs to be built, or reinforced. Often excavation of a basement floor is necessary to get enough height. The ceilings may be already built and need only insulation.

b. Cost of Refrigeration System

The cost is determined by the size of the condensing unit and the choice of coils. An experienced refrigeration man should be used to help choose the refrigeration system.

c. Cost of Building Materials

This cost will include all major parts of the mechanism as well as the small parts which will be listed in the selected detailed plans. The cost will depend on the size, location and quality of materials.

d. Cost of Labor

The construction of the freezer may be done by members of the family, skilled or unskilled, or by hired labor. The quality of workmanship will influence the cost and operation. The installation of the refrigeration unit needs to be done by a trained person. If unskilled labor is used for construction, the advice of a trained person should be obtained, in which case the instructions given should be followed carefully.

4. Construction of Home Built Walk-in

When building a walk-in refrigerator a well designed plan is required. A refrigeration engineer with experience should be consulted regarding these plans as to types and amounts of material needed and the kind of refrigeration equipment to be used. Because the construction is permanent, changes in design are difficult and expensive to make. The successful use of the farm refrigerator depends on the quality of workmanship, the materials used, and a good design. Detailed instructions should be followed carefully.

(1) Material and Parts Needed for Construction - A variety of materials are used in building a walk-in.

(2) Walls and Frame - Exterior finishes are built of wood, plywood, or tongue and groove lumber, concrete, brick, metal, and hollow tile. Wood is the easiest to work with and usually is less expensive. The standard frame varies with the insulation for the spacing of studs and joints.

(3) Insulation - Insulation may be chosen from numerous kinds which include cork, bark fibre, glass and mineral wood, wood shavings, plastics and insulation board. The materials with the

greatest number of air cells are the most efficient insulators. Cork is popular and is used as the basis for comparing efficiency of insulating materials. Insulation comes in different forms: (a) sheets, (b) rolls, (c) blocks, (d) bats, (e) loose and powdered type.

Some forms are stable enough to use as wall construction whereas loose filled types may be difficult to pack tightly. The choice of insulation depends on its insulation efficiency. (See table on page 75). The ease of installing, the cost, and the availability of the product and in addition its resistance to moisture, fire, vermin and absorption of odors. The use of thicker insulation means a greater initial cost for materials but a lower cost of operation. However, in practical use the initial cost of insulation has to be balanced against the savings in operating costs.

(5) The Vapor-Seal or Vapor Barrier - A vapor seal is a means for excluding the vapor moisture from the insulation and prevents the moisture in the outside air from entering. It may be made with an asphalt impregnated paper or heavy paper metallic foil on both sides. The vapor seal must be outside the insulation and must make a moisture proof seal. All cracks, seams, and nails must be sealed with a sealing material such as liquid asphalt. The paper and sealing material must be free of any odor of tar or benzine for these odors will be absorbed by the stored foods.

e. Doors and Door Castings

Doors and door castings are important parts of a walk-in refrigerator. Fit the insulated doors tightly to prevent sagging and warping. The casings need to be sturdy to support the heavy doors. The gaskets make a light seal to prevent air passage around the door. Ready built doors are often considered to be more successful than home built ones, although plans are available for building good doors.

f. Lids

Lift lids for a freezerchest should be counter-balanced. A tight fit with good gaskets prevents leakage of warm air into the freezer.

g. Hardware

Use hardware of a heavy duty galvanized refrigerator type. Safety type latches are used to provide for opening the door, both from the inside and out. A look may be provided to assure safety of the food.

h. Floors

Floor surfaces may be of concrete or wood.

i. Refrigeration Equipment

To obtain desirable results it is necessary that equipment be worked out by a qualified refrigeration man. Skill is needed for selecting the correct combination of materials and parts, the assembly, the installation and the adjustment of component parts.

j. Condenser

Adequate space must be provided outside the walk-in for the condensing unit which consists of the pressure control switch, service valves, and base. Air circulation is necessary to remove the heat from the condenser for efficient operation. The size of the condensing unit is determined by the total freezing and load, the design, the size of the walk-in, the materials used in the construction, and the expected ambient temperatures (surrounding temperature). Whether one or two condensing units are installed depends on the design of the refrigerator chosen and the total size.

k. Evaporator

There are four kinds of refrigeration evaporators in common use:

(1) Bare coils of tubing or pipe

(2) Plates

(3) Fincoils

(4) Unit coolers

The two general types are convection circulation type and the blower or blast type which uses a fan to circulate air over the coils. Any of the evaporators can be used in the chilling room but bare coils or plates are more satisfactory for the zero room. Unit coolers and fin coils frost too fast for efficient operation in zero temperature. Copper or aluminum tubing and iron and steel pipe are used for bare coils in the zero room.

l. Compressor

Standard compressor units of ½ hp., or larger are used. The unit selected should be correct for the voltage and type of service available. The size, design, insulation and use of refrigeration space will affect the required compressor. This should be specified in the complete plans.

m. Controls

Controls should be specified by the refrigeration serviceman and then depend on the kind of refrigeration equipment selected. The two types are thermal controls and pressure controls. The thermal control is preferred as it gives more constant temperature regulation.

n. Wiring and Lighting

Exposure to moisture requires moisture-proof wiring or conduit. Fixtures in the freezing and chilling rooms should direct light into the storage area as well as into the aisles. This is particularly needed in the freezer chest. A pilot light located outside the walk-in will indicate whether lights are on inside, or that someone is in the cooler room.

o. Alarms

Alarm devices such as those used on home freezers may be used on walk-ins.

5. Cost of Operation

Operating costs depend on the type and size of farm refrigerators, the amount and type of insulation, the temperature and humidity conditions, how well

the walk-in is constructed, the amount of food frozen, quantities of fresh and frozen food stored, and the care given and the electrical rates. An allowance for maintenance costs may be estimated at $23.00 to $35.00 a year. In general, home built walk-ins refrigerator operate at low monthly cost.

In one case, a check was made over a five year period on the electric current consumption of 50 cubic feet, top opening zero freezer and a large 300 cubic feet cold room operated at 35 F. It was located on the back porch about 6 feet from the kitchen. This refrigerator used 4,852 kwh in 74 months, an average of 65.6 kwh per month. Using the average figure of 65.6 kwh and electricity at .02 cents per kwh, the cost would be $1.21 per month. In another instance the kwh consumption was estimated at 125 kwh per month which cost $1.88 per month.

6. Care

a. Cooling room and freezer

In the walk-in refrigerator, both the chill room and freezer should be cleaned regularly. Clean the chill room in the same way as any food storage room. The accumulation of frost on the coils increases the cost of operation by reducing the efficiency of the refrigeration equipment. Frost can be scraped from plates and walls at regular intervals. For complete defrosting of the freezer, turn off electricity, remove food, and cover with blankets. Fans can be used to circulate the warm air into the freezer compartment. When frost is loosened, wipe moisture from coils, plates, and fins. Sharp instruments should not be used.

At this time, food should be sorted and checked to plan for use of older packages first.

b. Mechanism

The condensing unit should be kept free of dust and dirt. Lubricate according to instructions given by manufacturer.

The following table gives the comparative efficiency of different insulating materials.

Material	K "C"	Thickness equal to 1 inch of cork
Air, not in motion	.155	0.51"
Balco Barl	.280	0.93"
Mineral Wool	.290	0.96"
Cork	.300	1.00"
Firtex	.307	1.02"
Unifil	.330	1.10"
Celotex	.330	1.10"
Shavings	.400	1.33"
Fir	1.000	3.33"
Water	3.940	13.13"
Frost	6.000	20.00"
Brick	6.000	20.00"
Concrete	9.000	30.00"
Ice	13.900	46.33"
Steel	312.000	1040.00"

"C" is the conductivity of the material and represents BTU's of heat conducted per hour through one square foot of material one inch thick a difference in temperature on two sides of one degree F.

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SECTION VIII

SUGGESTIONS FOR THE MAINTENANCE OF HOME REFRIGERATOR EQUIPMENT

Introduction

The maintenance of household refrigeration equipment is not as complex as it was several years ago. With the present trend for prevalent use of sealed units, the entire mechanism can be removed from the cabinet as a unit when trouble occurs. This assembly is then returned to the refrigerator or freezer manufacturer for service.

With some home freezers, special equipment and a skilled serviceman is needed to remove the refrigerating mechanism. Some evaporators consist of an extensive tubing system that encircles the sides of the cabinet inner lining. Thus, for service, the compressor intake and exhaust tubes must be uncoupled so that the compressor with condenser can be removed from the cabinet. Since this complete unit repair service is possible, there is less need for local maintenance, other than removing and replacing the unit.

1. Recognition of Trouble

The owner of household equipment should be in a position to recognize some of the common maintenance problems, and to know what is required and how to get them adjusted. Before checking any problem, be certain to disconnect the appliance from the electric circuit. Never guess what should be done, but check some of the usual causes of trouble. If unable to determine the cause, call the serviceman.

Each model of refrigerator or freezer presents a particular maintenance problem, but there are general problems common to all models. Some of these are:

a. When the Refrigerator Does Not Run

First check the electric circuit. The difficulty may be due to the wiring or the cord plug. Correct the difficulty, then reset the switch or change the fuse, as required. If the light within the appliance is on when the door is opened, current is available for its operation.

Another condition is that the voltage may require regulation. This will cause the overload control to open, stopping the operation of the motor. If this is the trouble, call the power supplier. Still another reason may be that an

overload of warm food has been placed in the appliance just after the compressor has stopped at the conclusion of a running cycle. The internal refrigerant pressure differential is too great to allow the motor to start. After a time, the pressure will equalize sufficiently through the capillary tube so the motor will start and run normally.

If the difficulty is due to the motor, the thermostatic control, or a ground, it will require calling a serviceman.

b. When the Refrigerator or Freezer Starts But Soon Stops

This may be due to an overload that causes the motor to draw an excessive amount of current so that the overload trips to open the circuit. Remove all other appliances from the circuit and observe the operation. Other causes usually require the services of a repairman.

c. When the Refrigerator or Freezer Runs Most of the Time

Check the air movement to the condenser - it may be that the trouble is caused by dirt, the location of the appliance, or fan failure. Anyone of these will cause the condenser to work at a higher temperature.

To adjust this difficulty:

(1) Clean the dirt from the condenser with a brush or a vacuum cleaner.

(2) Relocate the appliance so there is at least 3 inches of space around the top, back and sides of the cabinet to permit air circulation.

(3) Fan failure will require adjustment or repair by a serviceman. There are other conditions that may cause the refrigeration equipment to run most of the time. Generally these require the services of a repairman.

d. When the Refrigerator or Freezer Is Not Cold Enough

First check the temperature control and adjust it to the proper setting. The cause may be due to:

(1) Overloading the appliance so that adequate air circulation cannot take place.

(2) Opening the door too frequently.

(3) Overworking the evaporator with too much freezing of food and ice.

(4) Heavy coating of ice.

All of these prevent the appliance from operating efficiently. If the homemaker observes good use rules, these troubles may be adjusted. In addition, the interior of the cabinet will be too warm if:

(1) The air flow is restricted to the condensers.

(2) The fan is defective.

(3) The cabinet light stays on when the door is closed.

The services of a repairman are required to adjust these troubles.

e. When the Equipment Does Not Freeze Fast Enough

This trouble may be due to improper setting of temperature controls or misuse of the unit, such as:

(1) Poor contact between the tray and the bottom shelf of the evaporator.

(2). The kind of tray that is used. Rubber and plastic trays do not freeze ice or food as fast as metal.

The solution to these problems is bvious.

f. When the Refrigeration Storage Cabinet Is Too Cold

This condition may be caused by a too high setting of the temperature control. By adjusting the control to normal setting, the difficulty may be corrected.

Another cause for a low storage cabinet temperature is high altitude (most refrigerator controls are adjusted to the altitude when installed). The temperature control setting will vary 1 degree F., lower with each 1,000 ft. rise in altitude.

When there are other difficulties with the temperature control, the adjustment usually requires the services of a repairman.

g. A Noisy Refrigerator or Freezer

Analyze the noise carefully. It may be caused by:

(1) The floor not being level.

(2) An overloaded evaporator unit.

(3) A loose mounting of the motor - striking the wall of the cabinet or other objects.

All of these troubles may be adjusted by the user.

However, when the mechanism is operating abnormally and when the noise is excessivly loud or unusual, consult a serviceman.

h. When the Equipment Runs Too Much

Be certain to check the methods used in the operation of the equipment, such as:

(1) Heavy use.

(2) High room temperature.

(3) Low temperature control setting.

(4) Restricted air flow to the condenser.

(5) Too much frost on the evaporator, or lining of cabinet. Some noises may be caused by improper defrosting.

These troubles are obvious and should be adjusted at once.

i. Motor Trouble

Be certain to check all of the possible use problems, as some of these will cause motor trouble. The most likely ones to do this are:

(1) An overloaded circuit.

(2) Too many warm foods placed in the cabinet.

(3) Lack of air circulation around the condenser due to dirt.

(4) Lack of air circulation around the cabinet.

All of these troubles can be cared for without the services of a repairman.

j. Replacement of Equipment Mechanism

When defects are found that require considerable work, the complete mechanism is removed from the cabinet of the refrigerator or some models of freezers. Generally, there are two plans used in such maintenance:

(1) The old mechanism is replaced by a complete new unit--the old one is returned to the factory or district repair station.

(2) The mechanism is returned to the factory or district station for repair after which it is sent back and reinstalled in the same cabinet from which it was removed.

Some maintenance shops carry "spare" units and install them in the appliance during the repair period. This is a convenience to the owner as he is assured of continuous refrigeration.

k. Excessive Kwh Consumption

A condition that causes the refrigerator to run too much, as mentioned above, will increase the kwh consumption. Other causes for excessive current use is usually mechanical and requires the services of a repairman. Be certain to check the cold control setting - a low setting requires longer and more frequent periods of operation.

l. Special Home Freezer Problems

In some freezers, the evaporator is large and the evaporator plates are housed between the inner liner and outer shell of the freezer cabinet. In such cases, it is necessary to handle the evaporator and compressor as separate parts. This type of maintenance requires services of the factory repairman. The care and maintenance problems of home freezers are similar to those of a refrigerator.

SECTION IX

ACCESSORY EQUIPMENT USED IN FREEZING FOODS

Little special equipment is needed for freezing foods. A few simple work tools found in most households will do a satisfactory job. The type of equipment that is ordinarily needed is two to three large bowls, knives, forks, spoons, tongs, measuring cups, and a large kettle or a specially designed scalding pan with an inset colander. The inset pan of the well cooker, with a wire basket or a square of cheese cloth is satisfactory for scalding. Also, the deep fat fry kettle with long handle wire basket or the water bath canner are suitable for scalding and cooling.

The only requirement for these utensils are that they be large enough to hold a quantity of water for scalding and cooling. (Avoid using copper, iron or galvanized kettles, since these metals may have an undesirable effect on the foods.)

Other useful equipment is a dish pan, clock or timer device, and a funnel for ease in filling containers. Stainless steel cutting knives are more satisfactory for use in cutting fruits and vegetables than non-stainless ones.

For convenience in handling some bags and liners a wooden block or mandrel is used for sealing the edges of the bag or liner.

A thermonstatically controlled hand iron or a special sealing iron is necessary for sealing some liners, bags, and wrapping materials.

A supply of clean dish cloths finishes the list of needed items.

All of the equipment, containers, and packaging materials should be assembled before starting the job of freezing.

SECTION X

NON-EQUIPMENT FACTORS AFFECTING THE FREEZING OF FOODS

A. Varieties and Types of Foods for Freezing

Food Management

Considerable time needs to be spent in planning for the family's frozen food supply. This includes the selection of varieties of fruits and vegetables to plant which will give the best quality product when frozen.

In estimating the amount of food to plant and freeze, consider how often each food will be served and over what length of time it will be used from the freezer. Remember, that the home freezers are limited in size. Therefore, planning is required to make room for the foods selected to freeze. The most economical use of the freezer is to extend the season of the fresh foods from a few weeks to several months in most parts of the country. By this method of planning, there is continuous removal of out-of-season foods and replacements made of those that are in season. Through a systematic use of the freezer space, most of the nutritional food needs of the family may be available during the year.

Ordinarily, some vegetables and fruits will be held for more than six months while others may be held for only a few days or weeks.

By keeping the freezer well filled with replacements an average turnover of three times per year may be expected.

Varieties of foods best suited to freezing depend on the climate and soil of a given area. Some varieties darken or discolor, become tough, and soften. The flavor in some foods is better than others, while there are those that have higher food values. In each region of the country, there are varieties which retain their original color, texture and flavor exceptionally well when frozen. Extensive experiments have been made in many states and accurate lists on the best varieties of fruits and vegetables for the different areas may be obtained from the State College of Agriculture, State Experiment Station, or the County Agent.

Some general points to observe are:

1. Varieties and Types of Vegetables and Fruits

Foods which yield good frozen products should be selected for freezing. Cultural conditions, disease, and insect pests affect the quality of the fruit and vegetable crop. The same variety may yield better frozen products from one year or season to another.

Of the many varieties of fruits and vegetables grown today, it must be emphasized that some are not suitable for freezing. Therefore, care must be taken in selecting those foods which not only freeze well but can be grown economically in the area where they are to be frozen. In choosing desirable varieties, choose one for eye appeal as well as for flavor.

If there is a doubt as to how well a food will freeze, test it before freezing a large quantity.

When planting a garden, always consider the varieties that are best adapted to free ing.

Because the varieties available and the quality of fruits and vegetables vary with the region in which they are grown, no detailed information is given. Research studies show that to obtain results of high quality where fine flavor and deep color are desired in the frozen product, a vegetable must be selected which is intense in color.

The color of vegetable or fruit not only helps the appearance of the frozen food but, in most cases, is a direct index of the vitamin content of the vegetable. The deeper the color of yellow and green vegetables, the higher the vitamin content.

There is another factor to consider in the selection of varieties for freezing. Some are more easily prepared than others, some vegetables are harder to shell than others.

2. Kinds of Food to Freeze

Vegetables which have long maturity and production seasons make for efficiency in freezing the amounts required to meet the family's needs.

The kinds of vegetables which are normally cooked fresh give desirable frozen products. While those foods eaten when raw and crisp such as lettuce, celery, radishes, and similar vegetables, ordinarily cannot be frozen successfully at this time. Cooked tomatoes may be frozen, but since they require heating to be desirable, it is more practical to process them by canning. Mild flavored varieties of peas, lima beans, green soy beans, sweet corn, snap beans, and peppers are suitable for freezing.

3. Good Quality Foods

The quality of food selected to freeze is important. Food taken from the freezer is no better than the quality of food put in. For best quality, choose fruits and vegetables that are harvested at optimum maturity. Select soft-ripe, not over-ripe fruits, free of blemishes, and vegetables freshly picked which are young and tender.

Neither does the quality of meat change when frozen. Therefore give consideration to grades and the proper methods of handling. A tough cut does not change into a tender one.

Freeze only meats from animals in prime, healthy condition when slaughtered. The quality of the meat is generally considered to be more tender and of better flavor if the animal is butchered when it is feeding well and gaining weight.

4. Maturity of Fruits and Vegetables

Ripeness or maturity has a decided bearing on the desirability of a frozen product. A tough, stringy vegetable gives an inferior frozen product, while tender healthy vegetables are flavorful and desirable when frozen. A mushy or a hard green fruit gives a displeasing, tasteless and many times a bitter product, while the fruit selected at the proper maturity makes superior frozen foods. Freeze only those foods at their best for eating fresh.

Optimum maturity means the point at which the vegetables or fruit is the most perfect for table use, not underripe or over-ripe. Peas at optimum maturity are sweetest, corn kernels are filled with a milk-like substance that is sweet and not starchy. Snap beans at optimum maturity are tender and brittle. It must be remembered the freezing process only retains the original quality.

5. Products With High Food Value

A consideration should be given to the products that yield high food value when making a choice of foods to freeze. Vitamin C values vary greatly for different vegetables. Frozen broccoli has a considerable higher Vitamin C content than many of the other garden vegetables and also higher than most fruits. Cauliflower and spinach are also comparatively high in Vitamin C. Vitamin B (Thiamin) is found in foods such as peas, asparagus, and spinach.

Vitamin A (Carotene) is found in the yellow pigment of vegetables. Minerals of some type are found in most vegetables. Iron is one of the most soluable of these. Care must be taken to preserve these elements during the preparation and freezing process.

6. Family Preferences

It is possible to determine with some accuracy the amount of each food needed for a year's supply. First, Use care to budget the space so that too much room is not given to one food especially if the family is not fond of it. Most families find the home freezer limited in space for all of the food they would like to freeze. Through a systematic plan for the use of freezer space, most of the nutritionally essential foods may be available the entire year.

There are authorities that recommend approximately one-half of the freezer space be used for meat products. These foods are expensive and highly perishable and in turn freeze well. Since vegetables are usually served frequently, one-fourth of the area should be used for these foods. The remaining space then should be used for fruits and other foods such as ready cooked products.

At least one study shows that families prefer frozen vegetables in the following order: peas, broccoli, spinach, snap beans, sweet corn, carrots, cauliflower and chard.

The following tables may serve as a guide in estimating the families frozen food requirements.

TABLE I

APPROXIMATE AMOUNT OF WASTE DISCARDED FROM VEGETABLES AS PURCHASED OR HARVESTED*

Vegetables	Quantity	Weight	Waste	Frozen Yield
		Pounds	Pounds	
Asparagus	1 crate 2 doz. bunches	24	6	15 - 22 pints
Beans, snap	1 bushel	30	3	30 - 45 pints
Beans, lima	1 bushel	32	19[1]	12 - 16 pints
Beets	1 bushel (52 pounds)	--	About $\frac{1}{3}$ the weight is waste	32 - 42 pints
Broccoli	25 pounds	25	13[1]!	24 pints
Brussels sprouts	25 pounds	25	5 - 3/4	20 pints
Carrots	1 bushel	50	18[1]!!	32 - 40 pints
Cauliflower	1½ bushel	37	20 - 1/3	30 - 32 pints
Corn, sweet	1 bushel	35	21 - 3/4	14 - 17 pints
Eggplant	1 bushel	33	4[1]	27 - 30 pints
Kale	1 bushel	18	6[1]	12 - 14 pints
Mushrooms	10 pounds	10	Less than 1 pound	10 pints
Peas	1 bushel	30	16[1]	12 - 15 pints
Peppers	1 bushel	25	4[1]	14 pints
Soybeans, green	50 pounds	50	13	- - - - - - - -
Spinach	1 bushel	18	3[1]	12 - 18 pints
Squash, winter	50 pounds	50	13	32 - 34 pints

*Adapted from Proximate Composition of American Food Materials, by Charlotte Charfield and Georgian Adams, U. S. Dept. of Agriculture Circ. 549, 1940

! Waste includes leaves and tough stalks.

!! Waste includes tops.

TABLE II

APPROXIMATE AMOUNT OF WASTE DISCARDED FROM FRUITS AS PURCHASED OR HARVESTED*

Fruits or berries	Quantity Purchased	Weight Pounds	Waste Pounds	Frozen Yield
Apples	1 bushel	48	5 - 3/4	32 - 40 pints
Blackberries	24-quart crate	36	None	32 - 36 pints
Cherries	1 bushel	56	3⅓	36 - 44 pints
Cranberries	1 box	25	--	50 pints
Peaches	1 bushel	48	5 - 3/4	32 - 48 pints
Plums and prunes	1 bushel	56	3 - 1/3	38 - 56 pints
	1 crate	20	1 - 1/8	13 - 20 pints
Raspberries	24-quart crate	36	None	24 pints
Strawberries	24-quart crate	36	1½	38 pints

* Adapted from Proximate Composition of American Food Materials, by Charlotte Chatfield and Georgian Adams. U. S. Dept. of Agriculture Circ. 549, 1940.

TABLE III

APPROXIMATE AMOUNT OF RAW FRUIT AND RAW VEGETABLE NEEDED FOR ONE CONTAINER*

Fruit	Amount of Fresh Product Needed to Fill 1 Quart	Vegetable	Amount of Fresh Product Needed to Fill 1 Quart
Apples	2½ pounds	Asparagus	1½ pounds
Apricots	2 - 3 pounds (halves)	Beans, lima	1½ to 2 quarts (in pod)
Berries (not strawberries)	1½ quarts	Beans, snap	3/4 pound
Cherries	1⅓ quarts	Beets	1 to 1½ pounds
Peaches	2 to 3 pounds	Carrots	1¼ pounds
Pineapple	2 pineapples	Corn	4 to 6 ears (Golden Cross)
Plums	1½ quarts	Greens	1 to 1¼ pounds
Rhubarb	2 quarts (diced)	Peas	2 quarts (in pod)
Strawberries	1½ to 2 quarts	Pumpkin or Winter Squash	2 pounds (in shell)

* From tables 4 and 6 in Cornell Extension Bulletin 583, Canning at Home, by Marion C. Pfund

NON-EQUIPMENT FACTORS AFFECTING THE FREEZING OF FOODS

B. Packaging and Wrapping Materials for Freezing Foods

Materials used for wrapping and packaging foods to be frozen serve many purposes. They keep the food fresh, help keep it sanitary and protect it from losses of moisture. The drying out of food causes changes in appearance, flavor and color. Meats and poultry may become coarse, tough, and dry and the fats will become rancid if improperly wrapped. The drying out is called "freezer burn" and is not noticeable on the surface of the foods affected. In order to properly protect foods from oxidation and from drying out, they must be wrapped or packaged in a material which will not allow passage of air and moisture.

1. Characteristics of Good Packaging Materials

a. Moisture-vapor-resistant to prevent loss of moisture which is in the air and in containers. Moisture-vapor can pass through cracks, seams and wrapping itself, making it important to have a good material and a good seal. A good moisture-vapor-resistant material will retain a satisfactory quality of fruits and vegetables during storage. Examples of this material are bags and sheets and waxed cartons made particularly for freezing.

b. Moisture-vapor-proof containers prevent the loss of moisture and liquid. Such containers are made of glass, metal, tin and plastic.

c. Sturdy, durable and pliable in zero and lower temperatures. It must withstand handling without breaking, cracking, or becoming unsealed. It should not become brittle and it must be resistant to puncture by bones. It should be strong either wet or dry.

d. Exclude oxygen to prevent chemical changes within the product.

e. Water and leak proof. Some foods will leak unless the packaging material is water tight. (This is different than a).

f. Protect foods from odors from absorbing odors and not give off odors from the material itself.

g. Non-absorbant to grease, oil, water or blood or give off flavors of its own.

h. Easily marked for identification.

i. Space saving packages with right angle corners, store more efficiently than round containers.

No single wrapper or container is satisfactory for all foods. The most important factors to check on packaging materials are that they be moisture-vapor-resistant and have adequate strength. However, in the use of these materials there are some other points to consider: tightness and ease of sealing, ease in emptying, possible reuse, care, and ability to obtain them locally.

2. Wrapping Material

Wrapping materials come in sheets and rolls. They may be of foil, film, waxed, laminated or a combination material. When used, they should be molded closely to the food to eliminate air. A good seal is important. Some need sealing with tape or twine and some are heat sealed. Foil seals itself when wrapped tightly around the food and the edges folded closely together. Some materials need a protection of stockinette or a second wrapping material.

There are two methods of wrapping foods: the confectioners (drug store) and "butcher" wrap. The drug store wrap is the easiest method to use in making a tight close fold and it uses less paper than the "butcher" wrap. Most authorities recommend the confectioners or drug store wrap method for packaging irregular and flat shaped foods for the home freezer. A single wrap of a good material will give a better protection than a double wrap of a poor material. Good materials cost slightly more than poor ones.

a. Aluminum Foil

Aluminum foil is one of the best packaging materials, however, during the national emergency this product is off the market. It is made in plain foil or laminated to paper or glassine. No tape or twine is needed to hold the folded ends. The recommended thickness is .0015 gauge with widths less than 24 inches and .002 gauge in 24 inch widths. It is used for flat and irregularly shaped foods such as meats, fish, fowl, pies and other foods. Household refrigerator type foil is not recommended for wrapping foods to be frozen.

b. Cellophane

Cellophane is a film product and requires heat sealing. All types of cellophane are not recommended for wrapping moist food such as meat. A grade such as Dupont cellophane MSAT 83 or 87 or Sylvania cellophane MSBI-3 are needed for moist foods. The laminated forms of cellophane wraps are stronger. The food should be placed directly in contact with the cellophane. An outer wrap is required to protect cellophane from breakage at low temperature. Stockinette or paper is used for overwraps. Cellophane materials should be stored in a cool room. Storage temperatures of 65 F. to 72 F. and 35 percent humidity, are recommended. The rolls should be kept wrapped and in the original containers. If cellophane has dried out, it may be located in a moderately humid place, to be restored.

c. Pliofilm

Pliofilm is a transparent rubber derivative and is available in sheet or bag form (not available at this time). It should be heat sealed. An outer wrap of stockinette or paper is needed. The recommended type of pliofilm is FF-140.

Extremes of temperatures and direct sunlight should be avoided when storing this material. It should be stored in the original container, the sheets lying flat in the box.

d. Transparent Films - Polyethylene, Vinyl

Additional transparent films are derivatives of polyethylene of vinyl. They are available in sheet or bag form. These materials are a durable plastic and will withstand handling at cold temperatures. These films are reusable and easily sealed by twisting the top of the bag on the ends of the package and then securing it with a rubber band, string, or clamp. A heat seal may be used but it is more difficult unless a special low temperature sealing device is used. A piece of paper may be placed over the edges to be sealed, then press with a warm iron. This helps to provide a satisfactory seal.

e. Waxed Papers

These materials provided only moderate protection and should be used only for short storage periods. A double wrap is needed if wax papers are used and the wax side should be next to the food.

f. Laminated Wrappings

These wrappings are 2 sheets of material fused together. They may be paper and glassine, paper and aluminum foil, paper and cellophane or 2 layers of cellopahne. One wrap is sufficient but twine or sealing tape is required to hold the material close to the food.

3. Stockinette

Stockinette is a loosely knit cotton fabric and is used as an overwrap to protect packaging material. It helps to keep the wrapping material close to the food. Stockinette is especially useful over odd shaped packages.

4. Tape

Low temperature tapes do not loosen during zero storage. They are used to seal the packages of frozen food. They are sometimes used over edges of wrapping or to cover accidental punctures and to hold labels on packages. Some tapes can be marked for easy identification. Ordinary packaging tapes are not satisfactory in cold temperatures.

5. Types of Containers

The two general types of containers are the non-rigid and rigid. The shapes are square, round, or rectangular. The sizes are usually quarts and pints. Cylindrical containers do not store as efficiently as those with square corners. Containers which stack easily conserve storage space. Ordinarily, waxed paper board containers should not be reused because of the difficulty of cleaning.

a. Glassine and Polyethylene Lined Cartons

These cartons are usually of the top opening type or rectangular boxes, and are easy to fill. They are ordinarily liquid tight.

b. Waxed Cartons

These boxes have snap-on lids of plastic, or waxed paper snap-in lids. No liner is required. Waxed cartons are used for liquid or dry packaging. They come in a number of sizes and shapes. The tub-shaped ones with disk-like, snap-in lids, and round shaped ones are filled easily. The contents can be removed without complete thawing, since the bottoms are smaller than the tops.

Square cartons with full-opening top and clear plastic lid, have tapered lides. The sides are easy to put on and to remove. With care, the lids may be reused. (Extra cartons may be purchased without the lids).

c. Waxed Folding Cartons (Collapsible)

These cartons have liners of cellophane, pliofilm, polyethylene, or a wax coated material and are good for vegetables and dry packaged fruits. Some of the liners may be heat sealed. The boxes give extra protection against the drying out of foods. The main function is to protect the liner from tearing. Boxes in good condition may be reused. The cartons or boxes fold flat when not in use. Windows are provided in some of these. In using the window type cartons, care must be taken in stacking to prevent the puncture of the inner liner which lacks protection over the window.

Both top and end opening boxes or cartons are available. These usually have either an outer over-wrap or an inner lining of moisture-vapor-resistant material. The over-wraps have to be sealed and are not reusable.

d. Bags Without Cartons

These containers are made for lined or waxed parchment, polyethylene, cellophane, pliofilm or other materials. After pressing the air from around food, the top edges of the bag should be folded over and heat sealed or press sealed, depending upon the type of liner. They are used for irregularly shaped foods or they may be shaped into form by use of molds.

e. Plastic Containers

These containers are made of molded clear or frosted plastic. They are used for liquid or dry-packed foods. They are square, with tapered sides, nest and stack easily. The lid is flexible to provide a good seal and is easily applied and removed. With care, this container may be used over the and over again.

f. Aluminum Foil Containers

These containers are made of a heavy weight foil and have a lid of the same material. It is not too practical for packaging liquids because the sides are not rigid; in addition the foil lid must be crimped on with a special tool. For these reasons, the container is not reusable.

It does have the advantage that the frozen food can be cooked in the container. Another advantage is that it is a good conductor of heat and the food is frozen faster in it than in some other types of containers.

g. Aluminum Pans

These pans are of the rigid type. The lid seals by friction. The container stacks well and is reusable. They can be placed in the oven directly from the freezer.

h. Tin Cans

Especially designed lacquered lined tin cans with a friction lid is on the market. A plain tin can of the food canning type may be used if it is sealed properly (vacuum). The tin cans that require a sealer must be reflanged before they are reused.

i. Glass Jars

Food may be frozen in glass jars especially designed for freezing, but head room must be allowed for liquids to expand. These glass jars for freezing have tapering sides with non-slip side ribs.

They have a full open mouth so that food can be removed without complete thawing. The lids are of two types; one or two piece metal rim. They are reusable and some lids are recessed for stacking. There is some possibility of breaking glass; care should be taken in handling. Glass jars may be reused.

Ordinary canning jars with the narrow neck are not too satisfactory for freezing foods as the neck prevents ease in removal of foods before thawing.

Round containers of all types use more space in storage than the square cornered ones.

6. Suggestions to Remember on Packaging and Wrapping Materials

a. Select containers suitable to the food frozen.

b. Choose a size to meet the family needs. A quart container of frozen food provides 6 to 8 servings of vegetables or 8 to 10 servings of fruit. A quart size is most economical of freezer space but unless the family can use this amount of food at one time, it is not a wise choice. Remember two pint bags can be put into a one-quart box. Pints thaw more quickly than quarts.

c. Containers should not be filled with too much food. The expansion of freezing foods may burst seals or containers; this will admit air and allow leakage.

d. In general, sheet and roll types of wrapping materials are used for firm shaped foods such as meat, poultry, fish and baked goods.

e. Rigid or semi-rigid containers are used for soft foods such as fruits, vegetables, mixtures, and ready cooked foods.

f. Bags are used in some containers and also over large items such as poultry. Bag-in-box is recommended for all packed frozen foods such as peas and beans.

g. It is important to have moisture-vapor-resistant packages to prevent oxidation. Remove all air possible to prevent loss of color, flavor, and food values.

h. Seal as directed for the particular type of material.

i. Containers with sloping sides pack in less space than cubes or cylinders. Rectangular packages utilize storage space more economically in the freezer.

j. Sealing is as important as using the right material or container.

k. In selecting containers consideration should be given whether they will be reusable. If they are reusable, a higher initial cost may be a saving over a long period of time.

7. General Care of Packaging Material

In general, packaging material should be kept in the containers in which they were purchased to protect them from dust and insects. Store in a dry, cool place. Excess heat and excessive moisture are to be avoided. Store in a place near a food preparation center for convenience. The utility room is an ideal place, if that is where the freezing and canning is to be done.

Containers which are reusable should be washed thoroughly and dried before storing.

SECTION X

NON-EQUIPMENT FACTORS AFFECTING THE FREEZING OF FOODS

C. Methods of Preparing Foods for Freezing

- 1 -

The Freezing of Fruits

Most of the suggested instructions contained in this section of the outline for home freezing of fruits are based on recent available publications listed in the Procedure for Home Freezing of Vegetables, Fruits and Prepared Foods, Agriculture Handbook #2, U. S. Department of Agriculture, September, 1950, and Home Freezing of Fruits and Vegetables, Home and Garden Bulletin, Bureau of Human Nutrition and Home Economics, U. S. Department of Agriculture, June 7, 1951.

"Freezing causes some breakdown of fruit tissues, discoloration and flavor changes." 1/ Therefore, care should be taken in the selection, preparation and packaging of fruits to prevent these undesirable changes.

Varieties of fruits differ according to the region in which they are grown. In each area of the country, there are certain varieties which retain their original color, texture, and flavor and are suitable for freezing. Be certain to select the fruit in the particular region that is best adapted to freezing.

Tree- or vine-ripened fruits contain more vitamins and a richer flavor than fruits picked green and allowed to ripen before freezing.

It is important to have as little delay as possible between the time the fruit is picked and frozen. If the fruits cannot be frozen immediately, place them in the refrigerator or some other cool place, then hold for only a short time before they are processed and frozen.

1. Use of Ascorbic Acid and Anti-Darkening Agents

Some fruits darken during freezing unless special treatment is given them Ascorbic acid (Vitamin C) is added to the sugar syrup or dry sugar packs with such fruits as peaches, apricots, figs and sweet cherries to help

1/ Nancy K. Masterman and Frank A. Lee, "The Home Freezing of Farm Products," Bul. 611, Rev. April 1950, Cornell Extension Bulletin, Ithaca, New York

preserve the flavor and color. These light colored fruits will darken and lose flavor when thawed if not treated.

The ascorbic acid may add some nutritive value to the food by enriching the vitamin content. Ascorbic acid does not produce a taste to the frozen fruit when used in recommended amounts.

Pure ascorbic acid may be purchased in crystalline or powdered form from a druggist or a locker plant.

There are some special commercial preparations on the market which contain some ascorbic acid. In addition, they ordinarily contain sugar and citric acid. Be certain to use the manufacturer's directions when using commercial anti-darkening mixes. To use, dissolve the substance in a small amount of cold water, then add it to the fruit before adding the sugar.

Citric acid - lemon juice: Some fruits may be treated with citric acid or lemon juice to prevent darkening. If citric acid is used, dissolve the crystals in cold water before adding to the fruit.

Add ascorbic acid to fruit juices by dissolving in a small amount of the juice, then slightly stir it into the entire mixture.

2. Steaming

Some fruits such as apples may be steamed to control darkening.

3. Suggestions for Obtaining a Good Frozen Fruit

a. Careful handling to prevent bruising.

b. Thorough cleaning.

c. Rapid processing.

d. Elimination of air by completely covering the fruit with juice or syrup or by the addition of an anti-oxidant, such as ascorbic or acidic acid.

e. Using a type of package which protects the fruit while in storage.

f. Rapid cooling.

g. Freezing and storing at 0 F.

4. Steps in the Preparation of Fruits for Freezing

a. Selection - Select fruits of the proper variety; firm ripe and freshly picked in perfect condition for eating.

b. Wash and sort - Wash berries, cherries and other small fruits by placing them in a collander and pouring cold water over them. The cold water helps to firm the fruit--warm water may cause "bleeding" and produces an undesirable texture.

Wash only a small amount at a time. Drain thoroughly, spread out on a tray or large dish on which a towel is placed to absorb the excess moisture. Place the tray in the refrigerator during the draining process.

c. Stem fruits - Lift off the caps of berries, never squeeze the stems off. Use a sharp knife, slipping it directly under the cap, taking care not to cut the center of the fruit. It is a convenience to use a snipping tweezer when capping berries.

d. Peel fruits - Many of the fruits such as apples, apricots, peaches, and pears oxidize and discolor rapidly after peeling. Some authorities recommend placing the fruit in a citric acid solution for about 1 minute before packing in sugar or syrup. (1/4 t. citric acid to 1 qt. of water.) Never allow the product to stand in the solution.

5. What About Chemical Peeling

Again in considering the most practical method for home usage, lye peeling is not recommended for household use. There are difficulties involved in the control of the process, and some dangers may be encountered in its use.

6. Seeding

Fruits with pits such as plums, peaches, and cherries should have the seeds removed before packing for freezing.

7. Purèeing Fruit

The fruit may be cooked or uncooked before forcing them through a sttrainer or pulper. Such fruits as grapes, raspberries, persimmons, peaches, plums and strawberries may be pureed without cooking.

An example of treating a puréed fruit is as follows: To each quart or 2 pounds of apricot puree, mix 1 cup of sugar for a clear bright product, add ¼ teaspoon of ascorbic acid dissolved in ¼ cup water. Add to the fruit pulp before adding the sugar.

8. Processing by Sweetening

Most fruits are not heated before packing. Generally, they are packed in sugar syrup or mixed with sugar to draw enough juice from the fruit to make a covering. When dry sugar is used, there is less liquid in the product.

Most fruits retain their natural flavor better when sweetened before freezing. However, for special diets and other purposes fruits may be frozen without added sweetened before freezing. However, for special diets and other purposes fruits may be frozen without added sweetening.

The method selected for packing fruit will depend on the expected use. Syrup packed foods are generally used for dessert. The dry sugar pack or unsweetened fruits are generally used for cooking purposes.

There are two methods of sweetening, the dry sugar pack and the syrup pack.

a. Dry Sugar Pack

After the fruit is washed, drained and cooled, the sugar should be evenly mixed through the fruit. A clean flour sifter will give even distribution. For most fruits, 1 part by weight of sugar to 3 of fruit is satisfactory.

Place only a small amount of fruit in the bowl. Sprinkle the required amount of sugar over the fruit and allow to stand a few minutes until the sugar begins to dissolve. Stir gently until the sugar is mixed with the fruit, and some of the juice is drawn from it. Then pack fruit and juice in the containers. To hold the fruit down, place a crumpled piece of moisture-resistant wrapping paper on top, then seal the container.

b. Syrup Pack

A syrup of the desired strength is poured over the fruits in the container. The fruit should be completely covered. The strength of syrups vary from 35 to 65%. Forty percent is used for most fruits. A heavier syrup is needed for

very sour fruits. Mild fruits may require a lighter one. Place the syrup in a covered container in the refrigerator.

Preparation of syrups: Syrups should be cooled below 70 F. before using. The syrup is made by dissolving granulated sugar in boiling water. Another method is to dissolve the required amount of sugar in cold water, stirring occasionally until the sugar is dissolved. Different strengths of syrups are used depending on the desired sweetness.

Syrup Table

Very thin	- 1 cup sugar to 4 cups boiling water
Thin	- 1 cup sugar to 3 cups boiling water
Medium - 40%	- 1½ cup sugar to 2 cups boiling water
Medium Heavy - 50%	- 1-3/16 cup sugar to 1 cup boiling water
Heavy - 60%	- 1-3/4 cup sugar to 1 cup boiling water

Use the strength syrup recommended for each fruit as given under the specific recommendations used. Estimate from one-half to two-thirds cups of syrup for each pint of fruit.

c. Substitutes for Sugar

Corn syrup or honey may be used in place of part sugar. To prevent a different flavor, always use 25% or less of the sweetening substitute. An enzyme converted corn syrup (example: sweetose) may be used entirely as a substitute; however, it produces a different taste from that of sugar. If saccarine is used it should be added just before serving.

9. Dry Pack

Some fruits such as cranberries and blueberries are usually packed without any sweetening.

10. Fruits for Special Diets

For special diets, many of the fruits such as strawberries, blackberries, gooseberries, raspberries and currents may be frozen without the use of sugar. For other fruits such as peaches and apricots, squeeze enough juice from some of the product to cover it. Ascorbic acid added to the juice protects the flavor and color. Ordinarily, frozen fruits packed without sugar appear to be more tart.

11. Packaging

The kind and size of packaging used will depend upon how the fruit is to be used: for sauces, jams, fruit desserts, and for pies.

Select a package size that will take care of one meal. (Frozen fruit loses its palatability if left standing after it is thawed.)

Use only firm, rigidly constructed, moisture-vapor-resistant and moisture-vapor-proof containers.

12. Filling Containers

In filling the containers, pack the fruit firmly without crushing it, then fill to within 1/2 to 3/4 inches of the top. There is enough air space around the fruit to allow for some expansion.

When using the "dry sugar pack," the sugar should be thoroughly mixed and dissolved before putting it into the containers.

If syrup is used, put the fruit in the container and pour just enough cold syrup over the fruit to cover it. When rigid waxed cartons, jars or tin cans are used, place crumpled cellophane, waxed paper, or foil on top of the fruit. It holds it under the liquid and prevents darkening. If carton liners are used, press air from the package, fold down the edges several times, seal with heat. For other liners, twist and fold down the ends several times and tie with string or rubber band or fasten with clamp. If it is a polyethelyne liner, it may be twisted and folded into a goose neck and tied with a rubber band. (Be certain that the juice covers the fruit.) To heat seal, use a thermostatically controlled hand iron, turned to the lowest setting. An electric sealing iron or curling iron also yield satisfactory results.

When using the hand iron, have available a wooden block, or a piece of heavy cardboard about three inches wide and an inch longer than the bag. Place the flap of the bag on the block and press quickly with the hand iron. Avoid sliding the iron over the flap.

13. Label

Label all containers of fruit with waterproof ink or chalk, giving the processing date, indicating the use

for which the fruit is intended such as dessert, pie or sauce. The sugar content may be noted as a guide for another year (1-2 or 1-3).

14. Freezing

After the container is filled, sealed and labeled, freezing should start immediately. If this is not possible, store in refrigerator until all of the packages are finished.

Always place the fruit in the freezer with the sealed side up. Follow the manufacturer's instructions for placing the fruit in the freezer for freezing. Ordinarily, for the first 24 hours, it is placed along the sides and bottom of the cabinet near the cooling coils or plates. Allow enough space between the packages for free passage of air.

The following table may serve as a guide for processing vegetables if local source material is not available.

CHART ON FREEZING FRUITS

FRUIT	HOW TO PREPARE	HOW TO PACK
Apples	Peel, core, and cut into sections of uniform thickness (medium sized apple, 12, larger more). Scald apples in steam or boiling water 1½ to 2 minutes to prevent darkening, then cool and drain. Or if syrup used for packing, slice apples directly into it. Leave head space, seal and freeze.	Pack with 1 part by weight of sugar to 3 or 4 parts by weight of fruit (1 c. sugar to 5 c. fruit); or in syrup to cover (1½ c. sugar to 2 c. water) add enough syrup to cover.
Apricots	Sort for ripeness. Wash, halve, and pit; cut in sections. To keep from darkening, dip for 1 or 2 min. in a solution of ¼ teaspoon citric acid in 1 quart of water, or use ascorbic acid. Leave head space, seal and freeze.	If apricots are not peeled, scald ½ min. cool immediately. Pack in 40% syrup (1½ c. sugar to 2 c. water). Cover fruit with syrup. Dry sugar pack use ½ c. sugar to 1 qt. fruit stir until sugar is dissolved. Use ascorbic acid to prevent darkening.
Berries, blackberries, elderberries, loganberries, except blueberries or strawberries	Pick over, wash, drain well. Prepare for packing fill containers leave head space. Seal and freeze.	Pack with syrup, to be served uncooked 40 or 50% syrup (see sugar strength table) Dry sugar pack 1 qt. berries add 3/4 c. sugar mix well.
Blueberries, huckleberries, elderberries	Pick over, wash, drain well. If desired steam for 1 min. and cool immediately. Package, leaving head space, seal and freeze.	For cherries to serve uncooked use syrup (2 c. to 1 c. water 65% syrup). Pack 1 qt. cherries add 3/4 c. sugar mix well.

FRUIT	HOW TO PREPARE	
Cherries, sweet	Select well-colored, tree ripened cherries. Wash, drain. Pit or not as desired. Leave head space, seal and freeze.	Whole cherries Pack in syrup (3 c. sugar to 4 c. water with ½ teaspoon ascorbic acid added to each 1 to 1½ c. syrup). Pitted cherries and crushed Pack in 1 part by weight of sugar to 4 parts by weight of fruit (1½ c. sugar to 1 qt. fruit ¼ t. ascorbic acid).
Cranberries	Stem, pick over, wash and drain.	Pack without sugar; or pack in 50% syrup or pack in syrup to cover (1-3/16 c. sugar to 1 c. water).
Figs	Select tree ripened fruit, sort, wash, remove stem, leave whole, halve, or slice. Piece if desired. Pack, leave head space, seal and freeze.	Pack without sugar; or pack in syrup to cover (3 c. sugar to 4 c. water, 3/4 t. of ascorbic acid).
Peaches (freestone and nectarines)	Select firm ripe peaches, sort, pit, peel. Cut halves or sections. To keep from darkening drop directly into cold syrup, use pack, leave head space, seal and freeze.	Put peaches directly into sugar syrup to which has been added ½ t. ascorbic acid for each qt. of syrup. To each qt. of fruit add 2/3 c. sugar. Mix well, sprinkle ¼ t. of ascorbic acid, mix in ¼ c. cold water to each qt. fruit Water pack without sweetening. Pack in qt. containers, cover with cold water to which 1 t. of ascorbic acid has been added.

FRUIT	HOW TO PREPARE	HOW TO PACK
Pineapple	Select firm, ripe pineapple. Remove outer covering, core and eyes. Cut in slices, dice, sticks or crush. Pack, leave had space, seal and freeze.	Pack tightly without sugar in containers or in 30% syrup to cover the fruit. Add ¼ t. ascorbic acid to each qt. of syrup.
Plums and Prunes	Select firm, ripe fruit. Sort, wash, halve, pit or leave whole. Pack in containers, leave head space, seal and freeze.	Unsweetened, pack whole in containers in syrup. Cover fruit in containers with 40 to 50% syrup. Add ¼ t. ascorbic acid to each 1 to 1½ c. syrup.
Rhubarb	Select firm, tender stalks. Wash, trim, and cut stalks, into 1 to 2 inch pieces. Pack tightly in containers. Leave head space, seal and freeze.	Pack raw or preheated 1 min. and cooled. Pack without sugar; or pack in 40% syrup to cover (3 c. sugar to 4 c. water).
Strawberries	Select firm ripe berries, sort wash in cold water and cap, drain well. Leave berries whole or slice. Large berries are better sliced or crushed. Pack in containers, leave head space, and freeze.	Sugar pack: Pack in 1 part by weight of sugar to 3 to 4 parts by weight of fruit (3/4 c. sugar mix thoroughly to 1 qt. fruit). Pack tightly so juice covers berries. Syrup pack: For better color, cover with water to which 1 t. of ascorbic acid is added to 1 qt. of water.

NON-EQUIPMENT FACTORS AFFECTING THE FREEZING OF FOODS

C. Methods of Preparing Foods for Freezing

- 2 -

The Freezing of Vegetables

Factors Affecting the Freezing of Foods

It must be remembered that the factors affecting the quality of frozen fruits and vegetables are:

(1) The selection of the raw product.

(2) Rapid handling of the product from the garden to the freezer.

(3) Methods used for processing and preparation.

(4) The quality of the packaging materials.

(5) The freezing method used.

(6) The temperature and the conditions of the storage space.

Fruits and vegetables are alive up to the time the vegetable is scalded and the fruit is actually frozen. Both of these foods have many characteristics that are common and likewise they have points of difference. It is necessary to have an understanding of the similarities and differences which are fundamental to the successful freezing of both fruits and vegetables.

Enzyme reactions start immediately after the fruits and vegetables are harvested and unless efficiently controlled, may damage the product to the time it is cooked or eaten. Care must be taken to retard the enzyme reactions throughout harvesting, processing of the raw products, during post-freezing, and storage.

When the enzyme action of foods is retarded prior to freezing, the characteristics of the fresh food is preserved almost to the natural texture and flavor. This may be accomplished in vegetables by scalding. Without scalding, it is impossible to obtain a high quality frozen vegetable. The heat is used to inactivate the enzymes thereby stopping them from changing the flavor

and destroying certain vitamins. The scalding also brightens the color of the product; saves space in the freezer since more scalded food can be packed in a container; in addition it makes packaging easier and reduces the number of bacteria. Scalding reduces some of the physical and chemical changes in vegetables but it is not intended that the process sterilize the food.

When vegetables are not scalded, the enzyme continues to be active during the frozen state and frozen vegetables fade in color and develop an "off" or "hay-like" flavor in a few months.

Some of the enzyme changes in fruits are retarded by the addition of sugar and ascorbic acid. These also help firm the fruit tissue and thus to lessen leakage when the product is thawed for use.

The fresher the fruit or vegetables when frozen, the more satisfactory is the frozen product. Gather or pick the vegetables and fruits as soon as they are mature. They should be frozen immediately after they are harvested. The quality soon becomes poor when it is stored at room temperature. The shorter time from the garden to the freezer the more desirable a product. After vegetables are harvested, they rapidly loose their tender texture and fine flavor. At room temperature in hot weather, Vitamin C and (carotene) Vitamin A losses are rapid. It is important that vegetables either be prepared for freezing at once after they are harvested or held under refrigeration until such time as they can be prepared.

The Freezing of Vegetables

The process used in preparing vegetables for freezing depends entirely upon the product packed. Remember, freezing will not improve the quality of a poor product.

Always check the instructions that are recommended by the state extension service or the state experiment station. Follow these recommended instructions for ways to prepare each vegetable and fruit.

The general methods suggested in this outline are based on recommendations from the reference material given in Procedures for Home Freezing of Vegetables, Fruits and Prepared Foods, Agriculture Handbook #2 U. S. Department

of Agriculture, September 1950, and Home Freezing of Fruits and Vegetables, Home and Garden Bulletin, Bureau of Human Nutrition and Home Economics, U. S. Department of Agriculture, June 7, 1951.

1. Type of Pack

For most vegetables, the dry pack method is satisfactory and is far less trouble than other methods such as brine or water.

2. Preparation of Vegetables

The methods used require care and speed in order to hold the color, flavor, texture and nutritive values during the normal storage of the product.

3. Steps in Preparation

a. Harvest the vegetables early in the morning before they become warm from the sun.

b. Wash and sort as quickly as possible. Prepare vegetables as you would for table use. Don't freeze foods that are bruised, over-ripe, decayed, or spotted. Wash thoroughly in clear water, lift out of the washing water so that the dirt will not drain back on the food.

c. Work with small quantities at a time. Peel, trim, slice, and sort according to size. Large pieces need longer scalding than the small and medium sized pieces. Vegetables have a better appearance when cut than broken. Trim off tough ends of stalks, leaves, or stems.

d. Scald by placing a small quantity of the product in a fine mesh wire basket or colander. (Scald only small amounts, about 1 lb. of food at a time so that all parts will be heated evenly.)

e. Cool promptly, pack and seal.

4. Time and Temperature for Scalding

Recommendations vary greatly in statements of time required for preheating different vegetables. Some of these differences are due to the methods used in counting time. Some directions indicate that preheating is timed from the moment of immersion of the vegetable in the boiling water; in other cases the time is counted when the water

returns to boiling. With a given heating time, the last method provides for more heat treatment than the first method. Scalding of vegetables is an important step in the processing of foods for freezing. This processing should last long enough for the heat to penetrate each piece and to raise the temperature to almost 180 F.

One method of time and temperature should be selected and followed carefully.

5. Water Scalding or Steaming

In the home, scalding foods in boiling water is simpler and in many cases considered the preferred method. This heat treatment is more likely to inactivate the enzymes.

When steam is used, it is necessary to assure adequate heating of all parts of the vegetable. This method requires more attention to details of procedure.

Unless products are steamed in thin layers, the results are inferior compared to scalding. However, the steaming method is described, since some research studies show that better retention of flavor and soluble nutrients is maintained in some foods by steaming. An example of this is broccoli.

a. Proportion of Water

Vegetables should be scalded in large quantities of boiling water. (At least one gallon of water to 1 lb. of vegetables.) For leafy vegetables, always use about 2 gallons of water to 1 lb. of vegetable. This will permit the water to return rapidly to the boiling point. The product will be over-scalded if it takes too long to bring the water back to boiling. Not more than one minute should be required. There is less cooling of the water if the scalding basket is kept in the boiling water and the vegetables packed into a second container for cooling and draining.

b. For Steaming

Allow the water to boil rapidly with full flow of steam before putting the vegetable into the pan. After placing the vegetable in the cooker, return the lid at once to prevent loss of steam.

c. Time for Scalding

Count the steaming time from the moment that a good flow of steam comes from the water. The time for scalding by steam assumes a temperature of 212 F. Count the water scalding time as soon as the vegetable is lowered into the boiling water and the lid is placed on the scalding pan.

6. How to Water Scald Vegetables

Dip the wire basket with the prepared product into rapidly boiling water; be certain to follow the directions for the time required to scald the particular food.

Lift the basket of vegetables up and down in the hot water a time or two to agitate the product, so the hot water will heat evenly all of the vegetable. Put the lid on the scalding pan or kettle, start counting the time immediately, keep the heat high for the entire time.

If the altitude is 5,000 feet or more above sea level, heat one minute longer than the specified time.

7. How to Steam-Scald Vegetables

Place the food in a wire basket on the pivoted rack of the pressure cooker or pan. Use enough water to keep the cooker from going dry but not enough to reach the food. The basket containing the vegetable must be low enough for the top of the cooker or pan to be closed tightly.

8. Cooling

As soon as the scalding is completed, plunge the vegetable into cold running water having a temperature of 50 to 60 F. or into a large amount of water to which ice has been added. These foods should be cooled very rapidly. If needed, change the water to maintain a cool temperature.

It usually takes as long to chill as to scald. Cool the product to about 50 F. or test by biting the food. When it feels cool to the tongue, remove from the cold water and drain thoroughly. Never leave the vegetables in the water longer than the time required for cooling. Cooling stops cooking and helps prevent loss of nutrients, flavor, and color. Mashed or pureed vegetables are cooled by floating the pan in cold water.

9. Packaging Vegetable

Select a moisture-vapor-resistant container of the right size. The size container will depend upon family needs and freezer space.

Box cartons with specially treated liners protect vegetables and are easily handled. Test the liners by filling with water to be certain they do not leak. Dry the liners and fill with the vegetable. Press out as much air as possible from around the food and be certain to keep the edges dry that are to be sealed or tied. In tieing a bag, twist the ends tightly, turn under and secure with rubber band, string, or clamps. For other type liners, heat-seal the edges with a warm iron. There are still other type liners that seal by firmly pressing the edges together. In either method, fold the edges and tuck into the box.

Waxed cups are convenient but the seal is not as vapor-resistant as the cartons with liners. Therefore, when used, seal edge of lid with tape.

Fill glass jars or other rigid containers allowing head space for expansion of the vegetable. Watery products expand more than others. Too much head space permits drying within the package; however, vegetables rehydrate when cooked in water so the loss of moisture is not serious.

10. Label Packages Plainly

Special stamps, pins, tapes, and crayons are made for labeling. Mark each package with the date, variety, kind of product, and any special treatment that may have been given the vegetable.

11. Freeze Quickly

Put a few packages at a time in the freezer or keep the packages in the refrigerator until all are ready for freezing. Freeze all vegetables as quickly as possible after they are packed.

Be certain that the temperature of the freezing area is 0 F. or lower. Do not freeze too many packages at one time. Follow the manufacturer's instructions as to how much food to freeze in a 24-hour period. As a guide, this will be about 2 or 3 lbs. of food per cubic foot of the available freezing space within the cabinet.

Overloading the freezer lowers the rate of freezing, which in turn lowers the quality.

For rapid freezing, place the packages against the walls and bottom near freezing plates or coils. Allow space between them so the air can circulate freely.

After the food is frozen, store at 0 F. or lower. Foods stored at high temperatures (10 F. and above) lose quality.

12. Chart on Freezing Vegetables

The following table may serve as a guide for processing vegetables if local source material is not available.

a. Vegetables Not Given In This Table.

This table gives recommendations for vegetables most commonly frozen. Other vegetables such as beets, brussels sprouts, cabbage, carrots, okra, mushrooms, and sweet potatoes have been frozen successfully and directions have been developed by some of the State Agricultural Experiment Stations. At this time whole tomatoes, lettuce, celery, and onions have not been frozen satisfactorily.

5,000 or more feet above sea level, scald the vegetables 1 minute longer.

VEGETABLE	HOW TO PREPARE	TIME TO SCALD
SOYBEANS	WASH THEM, BOIL IN PODS FOR 5 MINUTES, CHILL.	NO ADDITIONAL SCALDING REQUIRED.
ASPARAGUS	WASH WELL, CUT INTO DESIRED LENGTHS, SORT INTO 3 GROUPS ACCORDING TO SIZE OF STALK. SCALD, CHILL, PACK AND SEAL.	2 – 4 MIN. IN BOILING WATER, ACCORDING TO SIZE OF STALK. SMALL STALKS, 2 MIN. MEDIUM STALKS, 3 MIN. LARGE STALKS, 4 MIN.
BEANS, LIMA	SHELL, WASH, AND SORT ACCORDING TO SIZE. SCALD AND CHILL. SORT OUT ANY BEANS THAT MAY HAVE TURNED WHITE; THESE MAY BE COOKED OR CANNED. PACK LEAVING ½" HEAD SPACE. SEAL	2 – 3 MIN. IN BOILING WATER, ACCORDING TO SIZE. SMALL BEAN 2 MIN. MEDIUM BEAN 3 MIN. LARGE BEAN 4 MIN.
BEANS, SNAP	WASH WELL, CUT OFF STEM AND TIPS. LEAVE WHOLE, SLICE OR CUT INTO PIECES. SCALD, CHILL, AND PACK. LEAVE ½" HEAD SPACE. SEAL	2 – 3 MIN. IN BOILING WATER.
BROCCOLI	CUT OFF LARGE LEAVES AND TOUGH STALKS. WASH WELL AND SOAK, HEAD DOWN, IN SALTED WATER (4 TEASPOONS OF SALT TO ONE GAL. OF COLD WATER) FOR ABOUT ½ HR. SPLIT LENGTHWISE SO HEADS ARE NOT MORE THAN 1½" ACROSS. SCALD, CHILL, AND PACK. NO HEAD SPACE IS REQUIRED. SEAL.	5 MIN. IN STEAM. 3 MIN. IN BOILING WATER.

CHART ON FREEZING VEGETABLES

VEGETABLE	HOW TO PREPARE	TIME TO SCALD
CAULIFLOWER	SELECT WHITE, COMPACT HEADS. BREAK FLOWERLETS INTO PIECES ABOUT 1 INCH ACROSS. WASH, SCALD, CHILL, PACK, SEAL AND FREEZE.	3 MIN. IN BOILING WATER.
CORN, ON COB	HUSK, REMOVE SILK AND TRIM OFF BAD SPOTS. WASH, SCALD, CHILL, PACK, SEAL AND FREEZE.	7 MIN. IN BOILING WATER FOR SMALL SLENDER EARS; 9 MIN. FOR MEDIUM; 11 FOR LARGE THICK EARS OVER 1½" IN DIAMETER.
CORN, WHOLE GRAIN	HUSK, REMOVE SILK, AND TRIM OFF BAD SPOTS. WASH AND SORT ACCORDING TO THICKNESS OF EAR. SCALD, THEN CHILL. CUT KERNELS OFF COB. PACK, LEAVE ½" HEAD SPACE, FREEZE. FOR CREAM STYLE CORN, CUT THROUGH THE CENTER OF KERNELS AND SCRAPE THE COB WITH A DULL KNIFE.	4 MIN. IN BOILING WATER.
GREENS	WASH WELL, REMOVE IMPERFECT LEAVES AND LARGE, TOUGH STEMS. SCALD, CHILL, PACK, SEAL AND FREEZE. LEAVE ½" HEAD SPACE.	1½ – 2 MIN IN BOILING WATER. COLLARDS, 3 MIN. SPINACH 2 MIN.
PEAS	WASH, SHELL, SORT OUT IMMATURE OR TOUGH PEAS, SCALD, CHILL, AND PACK. LEAVE ½" HEAD SPACE. SEAL AND FREEZE.	1½ MIN. IN BOILING WATER.
PEPPERS, GREEN AND PIMENTO	WASH, REMOVE SEEDS AND SLICE OR CUT AS DESIRED. SCALD AND CHILL.	SLICED PEPPER 2 MIN. IN BOILING WATER. HALVES 3 MIN.

NON-EQUIPMENT FACTORS AFFECTING THE FREEZING OF FOODS

C. Methods of Preparing Foods For Freezing

- 3 -

Meats, Poultry, and Fish

On farms where home grown meats are processed, meats have a definite place in the home freezing program. Generally, much of the space in the home freezer is devoted to meat storage. Meat, like vegetables and fruits, for freezing, has to be handled properly to retain its original fresh quality and flavor.

Beef, pork, veal, and lamb are good when frozen provided it is from a good quality animal. Healthy young animals produce the best meat. It is true that freezing will not change a tough roast into a juicy tender one.

1. Meat Selection

In order to select good quality meats, it is necessary to know meat grades and proper handling. Generally there are two groups of meats which freeze satisfactorily:

a. Meats that are chilled and frozen at once - such as: chicken, pork, and fish.

b. Meats that are aged or tenderized for 5 to 10 days before freezing - such as: beef and mutton.

If the household lacks proper facilities for handling large amounts of meats, it is advisable to obtain the advice and services of a good butcher or local locker plant operator. Locker operators in most communities will slaughter, chill, cut, wrap and freeze the meats for a reasonable charge. This will help to assure that the home freezer is not overloaded after an animal is slaughtered. Detailed information on grades, cuts, and handling may be obtained from the State College of Agriculture, the State Experiment Station or from the U. S. Department of Agriculture, Washington 25, D. C., Farmers Bulletins #AWI-75, Freezing Meat and Poultry Products; No. 1186, Pork on the Farm -

Killing, Curing and Canning; No. 1615, Beef on the Farm - Slaughtering, Cutting and Curing; No. 1807, Lamb and Mutton on the Farm; No. 74, Boning Lamb Cuts.

2. Slaughtering

Thorough bleeding, cleanliness, and rapid cooling have much to do with a good quality product. Animals usually bleed more freely, produce a brighter carcass and dress easier if not fed (not water) for 24 hours before they are slaughtered.

The slaughtering, dressing, and cutting of meat requires skill. The best cuts and the highest quality of meat should be expected from the freezer, therefore, use care in slaughtering animals if the meat is to be frozen.

3. Cooling

After the animal is slaughtered, the carcass requires rapid cooling to prevent spoilage and a poor quality of meat.

It is important to hang the carcass where it will cool without freezing, if possible in a refrigerated room.

The proper temperature for cooling is about 34 F. The time required depends upon the size of the carcass. Veal, lamb and pork are chilled in 24 to 36 hours, larger ones may take as long as 72 hours.

4. Aging

The length of time for aging varies, depending upon the kind of animal and the individual taste. The purpose of aging some kinds of meat is to increase the tenderness and to develop flavor.

The method used for aging is to place the meat in a cool room of 34 to 38 F. with a humidity of 85 to 90%. 2/ When the air is too dry, shrinkage in weight takes place.

The time for aging beef varies depending upon the fatness and whether the meat is to be frozen at 0 F.

2/ J. D. Winter, Andrew Hustrulid, Lillian W. Anderson, Freezing Foods for Home Use, University of Minnesota Agriculture Extension Service, Extension Bulletin No. 244.

The present practice is to age it from 5 to 9 days. Beef with little fat may spoil if held for more than five days. Well finished beef (commercial and choice grades) may be more tender if aged for a slightly longer time.

One study shows that there is little advantage as far as tenderness is concerned in aging beef that is to be frozen. 3/ Over-aging of meat that is to be frozen shortens the length of time it may be stored in the freezer.

Pork, fish, poultry and veal are not aged but packaged and frozen as soon as thoroughly chilled. Ordinarily lamb is not improved by aging but if undertaken, not more than 1 to 3 days.

5. Cutting*

Cut meats for freezing into table-sized pieces to fit the needs of the individual family.

To conserve on freezer space, save wrapping materials, and lessen danger of puncturing the wrapping have most of the meat boned.

All cuts of meats having a high percentage of bone should be boned. Boning reduces by as much as a fourth, the storage space needed for meat in the freezer.

Tougher or less desirable cuts such as chuck or brisket may be boned and cut into stew meat or ground.

Removal of bones prior to freezing has no effect on the flavor or juiciness of cooked meat.

If the meat is not boned, have the rough edges of bones removed to prevent holes being torn in the wrapping material.

3/ Nancy K. Masterman, and Frank Lee. The Home Freezing of Farm Products, Cornell Extension Bulletin No. 611, revised April 1950, Ithaca, New York.

*Check with the State Experiment Station of the State College of Agriculture for detailed information on recommended practices for cutting meats.

If the meat is cut by a skilled meat cutter, be certain to specify the thickness of steaks, chops, and the size (lbs.) of roasts. Give definite instructions as to the proportion of stew and ground meat desired. Conserve the tail end of steaks by using in ground meat.

6. Meat Yields

On planning for the freezing and storage of meat in the freezer, the question arises as to the expected yield of meat from an animal or carcass.

It is understood that any estimate will vary depending on the type and quality of animal.

Front quarters of a carcass are more economical in price and yield of meat. Generally the choice and lower grade of the front quarter will yield about 90% of their weight in cuts and ground beef. Prime and hind quarters yield about 75%. The good or lower grades of the hind quarter will yield about 82% of the cut.

The following table will serve as a guide when figuring yields of meat:

APPROXIMATE YIELD OF EDIBLE MEAT
(% of Live Weight)

	Live Weight	Dressed Carcass Yield Before Cutting		Packaged Meat Yield After Cutting	
	Lbs.	Lbs.	Percent	Lbs.	Percent of Desired Carcass
Beef	750	410	55	325	80
Pork	225	180	80 - 35 Lb.	130	78
Veal	200	110	55 lard	90	82
Lamb	90	45	50	35	78

APPROXIMATE AMOUNT OF WASTE DISCARDED FROM POULTRY AND POULTRY PRODUCTS*

Food	Quantity Purchased	Weight	Waste
		Pounds	Pounds
Eggs	Case, 30 dozen	45	5-7½
Chickens:			
Broilers	1 live bird	1½-2½	3/4-1¼
Fryers	1 live bird	2½-3½	1-1/6-1-2/3
Roasters	1 live bird	More than 3½	More than 1-2/3
Turkeys	1 live bird	10	4

*Adapted from Proximate Composition of American Food Materials, by Charlotte Chatfield, and Georgian Adams, U. S. Dept. of Agriculture, Bul. #549, 1940

7. Wrapping and Packaging

Always follow recommended practices for packaging all kinds of meat and poultry. Meats are wrapped to prevent drying out and from absorbing flavors. Drying out of meat in storage is a big problem, some cuts of meat will lose as much as 10% gross weight in a year's time. Therefore it is important to use skill in wrapping meat, poultry, and fish. The materials may vary in form but all of them must be moisture-vapor-resistant.

Good materials of a quality to best protect the meat from losing moisture are coated papers, films, film bags, aluminum foil or combinations of these materials. When films are used, it is necessary to protect them with an outer wrap of stockinette or similar material. The overwrap prevents breakage of the wrapping material and it holds the films tightly to the meat, which helps to eliminate air pockets. A good technique in wrapping is as important as good paper.

8. Packaging Meats

a. Steaks and Roasts

Before wrapping, trim off the excess fat and bone. Shape the meat into a compact piece in family size servings to prevent air pockets.

Press the paper firmly against the meat, forcing out all air possible.

The drug store wrap is well adapted to packages that are kept flat such as steaks, chops and roasts. This method takes a minimum amount of paper.

To form the drug store wrap place the piece of meat on the center of the wrapping material and draw the paper as tightly as possible to the meat, then fold the ends together and roll or fold them tightly under the food forcing out as much air as possible. Tie securely or seal the seams with cold storage tape. All packages must be wrapped tightly to keep out air pockets.

If more than one piece of meat is put into one package, lace two pieces of film, cellophane or freezer wrap between the pieces of meat so they can be separated easily before thawing.

b. Ground Meats

Pack ground meats in amounts suitable for use later, such as meat loaf, or chile, (meat loaf may be mixed before packaging). If desired, shape the meat into patties, being certain to separate each patty by two layers of paper. Place the ground meat into moisture-vapor-resistant cartons or wrap as for roast and steaks. All packages must be as nearly air tight as possible, then sealed, taped and enclosed in stockinette.

c. Sausage

Mix the ground pork with the seasonings, omit salt as it activates oxidation which causes rancidity. Salt after the product is thawed. Sausage that contains a large proportion of fat becomes more rancid than when lean meat is used. Smoked sausage has longer storage life than un-smoked sausage when other factors are equal. Smoking helps to stabilize the color, partially sterilizes the meat, increases the tenderness, and dries off some of the moisture.

d. Ham and Bacon

All cured meats must be wrapped carefully and sealed in moisture-vapor-resistant material to prevent other frozen foods from being effected by the odor of smoke.

Ordinarily frozen ham and bacon does not keep as long as fresh pork. "Aged" cured meats will remain in good condition for many months while freshly cured meats

lose some of their color and flavor during freezing. 4/ The length of time it can be kept at 0 F. depends on how well it is handled and the method used for curing and smoking. For best results these meats should not be sliced before freezing, as it shortens the storage life. 5/ Freeze hams whole or in halves, bacon in sizable pieces. Wrap as for roasts.

e. Lard

Pack freshly rendered lard in metal containers or wrap in greaseproof packaging material.

f. Big Game Animals

These animals are handled, packaged and wrapped in the same way as beef. Be certain to trim parts that were damaged by gun shot.

9. Labeling

It is important to label meats with the date, weight, kind, and cut, so the individual package can be found easily. To help find meats in the freezer, tags of different colors or papers of different colors may be used, one color for beef, another for pork and still another for veal, etc. If cellophane and stockinette are used place the label between the cellophane and the stockinette.

Marking pens and special pencils are used to write on all types of surfaces.

10. Freezing and Storing

After the packages of meat are labeled, place them into the freezer immediately. Locate them either in the freezing compartment of the freezer or place the packages along the walls and bottom of the freezer, leaving about one inch space for good circulation of air to remove the heat. Allow the package to remain in this position until thoroughly frozen, a minimum of 24 hours.

4/ J. G. Woodroof, Ethyl Shelar, Home Freezers and Home Freezing, Bul. #266, March 1950, Georgia Experiment Station, University of Georgia.

5/ Walter A. Maclinn, Marie C. Dermin, Frozen Foods, Extension Bul. #249, 1948, Extension Service, Rutgers University, New Brunswick, New Jersey.

After it is completely frozen, remove to the storage area for meat. Remember not to overload the freezer with meat and meat products. Overloading is harmful to the freezer and it may cause thespoilage of other foods stored in the freezer. Follow the manufacturer's instructions as to the amount of food to be frozen at one time.

The food then may be stored at 0 F. in the freezer. Proper storage conditions add much to the life of frozen meats. If the freezer temperature, humidity, and air movements are right, with other conditions equal, the frozen meat product will be satisfactory. A minimum storage temperature of 0 F. is recommended. Fluctuating temperatures up to 15 or 10 F. above zero allow for rancidity or breakdown processes to develop. These temperatures are only satisfactory for short storage periods.

The following table may serve as a guide as to the length of time for the storage of meats.

Product	Suggested Maximum Storage Time
Sausage and other ground meats	1 - 3 months
Fresh pork	6 - 9 months
Lamb, Veal	6 - 9 months
Beef	6 - 12 months

These are only approximate guides since there are no set limits established by research for the definite storage life of different foods. However, it is known that no frozen foods improve in storage.

Remember that rapid turnovers of food in the freezer mean a better quality of food and economical use of freezer space.

11. Freezing Poultry

a. Poultry

Select young, healthy, well finished birds.

b. Kill and Dress

To obtain good bleeding, easier drawing, and improved flavor, starve birds (except for water) for 24 hours

before killing. Do not use food containing fish oil or meal for at least two weeks prior to killing in order to prevent a fishy taste.

Birds may be killed by a number of methods, follow a recommended practice. One way is to kill the bird by cutting the throat and hang it by the legs to prevent bruising.

Pluck the feathers while the bird is still warm. To loosen the feathers of the fowl completely submerge it (except the feet) for about 30 seconds in water at 128 to 130 F. The temperature of the water and length of time for dipping depends on the age of the bird. Remove all pinfeathers, singe, wash thoroughly in cool water, draw or eviscerate the bird while still warm and wash again. If desired remove the wing tips.

c. Cool Rapidly

Remove the body heat quickly, it will require 2 to 3 hours or longer depending on the size of the fowl. Use crushed ice or chill in ice cold water or cold morning air. Freeze poultry within 8 hours after killing but not sooner than 3 hours.

d. Preparation

The birds may be frozen whole, disjointed, split or cut up, depending upon the use to which it will be put after storage.

Remove most of the body fat, since fat becomes rancid.

Birds for roasting may be stuffed before freezing.

Cut-up chicken takes up less space in the freezer than whole ones.

e. Wrapping and Packaging

When birds are wrapped similar to roasts, be certain to close the cavity and tie the feet closely to the body.

When poultry is hot wrapped well, it dries out rapidly (freezer burn) in storage.

The easiest type material for packaging fowl are the pliable film bags, and if desired use a stockinette outer wrap. Aluminum foil sheets, and film bags designed to shrink and fit tightly to the fowl are all satisfactory materials.

All wrapping materials should be moisture-vapor-resistant.

(1) Roasters - Wrap the bird in a pliable material or place it in a freezer bag. When using film bags remove the air pockets by immersing (bird in bag) in warm water. Seal the package by tying with rubber band, string or clamp.

If cellophane is used for the wrap apply stockinette, cheese cloth or locker paper as an overwrap. Be certain to wrap the giblets separately and use within 3 months.

(2) Broilers - Split the bird through the center back, lengthwise, and place two pieces of locker paper between the halves. Wrap in moisture-vapor-resistant material, seal and freeze.

(3) Fryers and Cut-Up Chicken - Wrap in moisture-vapor-resistant material, place in cartons, in freezer bags or wrap, remove as much air as possible, seal and freeze.

Sometimes the bones of young birds become darkened. This is the result of seepage of hemoglobin from the marrow, it does not affect the flavor, the defect is only appearance. 6/

(4) Turkeys - Dress turkeys the same as chickens. After turkeys are thoroughly cooled, wrap the liver, giblets and neck separately in moisture-vapor-resistant material (seal or tie) place them under the wing of the bird. Wrap the turkey in moisture-vapor-resistant polyethelyne bags or wrapping sheet material, seal the package and freeze immediately.

(5) Duck and Geese - Ducks and geese are usually dry picked and handled in the same way as other fowl; however, be certain to remove as much air as possible from the cavity. This may be stuffed with dressing if desired. Wrap with moisture-vapor-resistant material, seal and freeze.

6/ F. D. Winter, Andrew Hustrulid, Lillian W. Anderson, Freezing Foods for Home Use, University of Minnesota, Agriculture Extension Service, Extension Bulletin #244.

12. How To Freeze Fish

Prepare fish as for table use, wash thoroughly. Freeze small fish whole, other fish may be cut into steaks or fillets. Since fish spoil rapidly, it should be frozen as soon after being caught as possible. If necessary to hold, pack it in crushed ice or in a cold place in the refrigerator. Wrap the fish in cellophane or other wrapping material and place in heavily paraffined cartons or other moisture-vapor-resistant material.

To prevent leakage in thawing dip lean fish in a cold salt brine (1 cup salt to 1 gal. water). 7/ Wrap with moisture-vapor-resistant material, seal and freeze. Be certain to store it in the coldest part of the freezer where the temperature is lowest. If possible store at - 10 F.

To glaze fish, freeze them unwrapped. Dip the fish in cold water, let an ice film freeze over them and repeat the dipping and freezing until the fish are coated in ice. 8/ Then wrap in moisture-vapor-resistant material.

13. Sea Food

Wash oysters, clams and scallops in salted water. Package in liquid-tight containers, and freeze quickly. Crabs, lobsters and shrimp - clean and prepare by steaming as for the table, 10 to 15 minutes. Package in moisture-vapor-resistant material, (glass jars or cans) seal and freeze quickly.

7/ F. D. Winter, Andrew Hustrulid, Lillian W. Anderson, Freezing Foods for Home Use, University of Minnesota, Agriculture Extension Service, Extension Bulletin #244.

8/ Nancy K. Masterman, Frank A. Lee, Home Freezing of Home Products, Cornell Ext. Bulletin #611.

NON-EQUIPMENT FACTORS AFFECTING THE FREEZING OF FOODS

C. Methods of Preparing Foods for Freezing

Ready Cooked Foods

It is a convenience to freeze some cooked foods. By careful planning, a great amount of time, energy, fuel, and trips to market can be saved if some ready cooked foods are frozen in advance of their need. An example is the food for the school lunch, when prepared in quantities several days in advance and frozen. The secret of the success of ready cooked foods is rapid turn-over, because many cooked foods lose their flavor after a short storage period.

Research studies show that some cooked foods are far more satisfactory to freeze than others. Foods such as breads, baked beans, stews, chicken a la king, meats, pies, cakes and cookies retain a high quality of flavor, texture and general appearance when frozen.

1. Factors Affecting the Preparation of Cooked Foods for Freezing

High quality - The quality of cooked foods to be frozen must be of a high standard. Freezing never makes a top quality food out of an inferior product, nor does it sterilize food; however, low storage temperatures do prevent harmful bacteria, yeasts, and molds from growing. In high storage temperatures, some of the bacteria may product toxius. Therefore cleanliness and sanitary handling of these foods for freezing is a must. The water must be pure and the equipment and containers as clean as possible. Be certain that the hands are cleaned thoroughly before packing. Remember that ready cooked foods may spoil more quickly than raw foods.

Heat foods thoroughly before freezing. Temperatures between 130 F. and 168 F. are conducive to spoilage. 2/ Bacteria grows especially rapid in creamed foods when left at room temperature. Be certain that ready cooked foods are not contaminated between cooking and freezing.

2/ J. D. Winter, Andrew Hustrulid and Lillian W. Anderson, Freezing Food for Home Use, Bul #244, University of Minnesota Agriculture Extension Service.

Cook quickly - Cook foods quickly, cool them promptly and rapidly to prevent over-cooking, and then freeze rapidly. During slow cooling the food stays longer in the temperature range in which bacteria multiply. To hasten cooling, lower the pan in which the food is cooked into ice water, stir slighly, use care to prevent breakage of the food. Keep the pan covered to help prevent loss of flavor.

The loss of flavor in some ready cooked foods is due to evaporation during slow-cooking; work quickly to avoid this difficulty.

It is recommended that seasonings be added it serving time, since salt loses strength during freezing and storage and pepper may become bitter.

Some undesirable flavors during cooking are caused through chemical changes, such as the oxidation of fats which result in rancidity. On the other hand, some foods contain substances that help prevent oxidation. Pork cooked with baked beans prevents the fat from becoming rancid.

Other methods are used also, such as adding acids to red, white, and yellow vegetables to help retain the color. The addition of orange juice to sweet potatoes helps prevent a grayish color. Beating sauces with the electric mixer at high speed helps to keep them from separating and curdling when thawing.

When planning to freeze ready cooked foods, always consider the expected quality of the finished product and the economy of time and fuel.

2. Packaging Ready Cooked Foods

Correct packaging of ready-cooked foods is essential. Unless particular care is given to wrapping in moisture-resistant materials, the moisture will evaporate from the foods causing dryness, loss of flavor and poor texture. Different kinds of foods require different wrapping or packaging.

Some suitable types of packaging materials used in freezing ready cooked foods are cylindrical waxed container, round nesting waxed cups with tapered lids, square or rectangular cartons, freezer film bags, especially treated paper, films, metal foil, plastic containers, and jars (tin and glass).

3. Packing

a. All types of cooked foods should be packed as solidly as possible to avoid air spaces in the container. Wrap tightly, pushing out all air spaces except the space at the top for expansion of foods during freezing.

b. Package foods immediately after cooling in frozen food containers of a size to meet the family's needs.

c. Exclude as much air as possible in packaging.

d. Fill the containers with only enough food to serve at one time. Never refreeze ready cooked foods.

e. Place a layer of two pieces of cellophane every few inches throughout the package of soft foods, such as creamed chicken. This speeds reheating as the sections can be separated.

f. Use proper containers for packaging ready prepared uncooked foods such as cake, batter, and dough. A sturdy grease-proof, non-odor container is best, such as glass, aluminum and especially treated papers, with a tight seal in which the food may be reheated as well as frozen and stored.

g. Allow head space at the top of container for expansion.

h. Date and label each package, also giving kind of food.

i. List foods on inventory sheet.

4. Freezing Cooked Foods

The quicker the freezing the less the breakdown of the foods, and the quality will be better.

Place the packages against the walls or bottom of the freezer cabinet, leaving space between them for passage of air.

Freeze only a few packages at one time.

5. Temperatures and Storage Time

Cooked foods become less dry when stored in a freezer with very little temperature fluctuation. Air at low temperature tends to dry out foods, with loss of flavor.

With rising temperatures, the moisture tends to pass from the food into the air spaces of the container, then with the lowering of the temperature the moisture forms as ice or frost on the surface of the container. Result of these temperature fluctuations is a lowered quality of food.

The minimum storage temperature of all foods is 0 F. The storage life of cooked foods will be longer if stored at a lower temperature.

Freezing will retain cooked foods only through a reasonable time. Therefore, the storage time is shorter than for most uncooked foods.

The storage time of cooked foods will vary from a few days to a few months according to the type and kind of food frozen. A rapid turnover is necessary for the success of all cooked foods as many of them lose their particular flavor within a comparatively short time. From a practical point, there is little reason for storing large quantities of cooked foods in the freezer. The ingredients for most of them are generally available in the home throughout the year.

Summary

To obtain a high quality ready cooked frozen food, follow these tips:

a. Use a tested recipe when preparing cooked foods for freezing.

b. Select a high quality raw food.

c. Select a variety of food that freezes well.

d. Cook foods well with a good proportion of ingredients and at the correct temperature.

e. Handle carefully.

f. Cool rapidly and fill the containers rapidly.

g. Freeze rapidly and store at a low temperature.

h. Use the right method for thawing and heating these foods.

i. Store only for the proper period for the particular food. It is not economical to store ready cooked foods over long periods of time.

The following table may serve as a guide in planning the maximum storage time for ready cooked foods.

APPROXIMATE STORAGE LIFE OF SOME COMMONLY COOKED FOODS*

Food	Condition when Frozen	Maximum Storage Months
Cakes, fruit	Baked	12 or more
	Unbaked	8 - 9
Cakes, butter	Baked	4 - 8
	Unbaked	2 - 3
Pies, mince	Baked	6 - 10
	Unbaked	6 - 10
Pies, fruit	Baked	2 - 6
	Unbaked	2 - 6
Bread, yeast	Baked	12
	Unbaked	$\frac{1}{2}$ - 2
Rolls, yeast	Baked	12
	Unbaked	$\frac{1}{2}$ - 2
Cookies	Baked	2
	Unbaked	6 - 9
Fruit	Puree	6 - 9
Salads	With solid base	4 - 6
Vegetables	Puree	6 - 9
Sandwiches	- - - -	$\frac{1}{2}$ - 3
Biscuits, baking powder	Unbaked	$\frac{1}{2}$ - 1
Meat and poultry	Roasted	3 - 8
Meat stew	Cooked	2 - 8
Stewed chicken	Cooked	4 - 8

*Faith Fenton and June Dorfler, Foods from the Freezer Precooked and Prepared, Cornell Bul. # 692, Ithaca, New York

SECTION XI

PREPARATION AND COOKING OF FROZEN FOODS

Introduction

Some frozen foods may be cooked without thawing, others may be thawed completely or partially thawed before cooking. Most foods should be thawed in the original container, except those foods cooked from the frozen state. By careful thawing and serving at the right time of defrosting, it is possible to prepare attractive frozen foods.

Directions for cooking and serving should be followed carefully.

Properly defrosted and prepared frozen foods are generally as good as the fresh product. These foods should be prepared and served to keep as much of the natural or fresh flavor, taste, color, structure, and internal juices as possible. The food value and quality depends on how they are treated before being frozen, how long they are kept after thawing, and how they are prepared or cooked for the table.

The recommendations for thawing and cooking differ with:

(1) The kind of food.

(2) The way it is to be used.

(3) The method used in processing.

(4) The size of the package.

Plan to use thawed foods at once. Avoid refreezing of foods as there is a possibility of spoilage. Both fruits and vegetables become flabby and loose their shape after thawing. Fruits do not change as rapidly as do vegetables.

1. Methods of Thawing Foods

There are two methods of thawing foods, the slow thaw and the quick thaw. If foods have a tendency for leakage of fluids, such as some cuts of meats and fish, thaw slowly so that the tissue solids will be reabsorbed.

To thaw foods slowly, place them in the storage compartment of the refrigerator until thawed. The rate of thawing may be increased by allowing the food to thaw at room temperature. To thaw foods quickly, use warm water to surround the package, (do not allow foods to become wet) or fan may be placed in front of the food which speeds thawing. Another method for quick thawing is delectric (electronic). This technique is used by some of the large institutions, as it affects a saving of time and practically eliminates the possibility of bacterial growth during the thawing period. At this time, it is not a practical method for home use.

Foods when thawed become highly perishable and do not keep as well as the same kind of fresh foods.

The following table gives the approximate thawing rate of fruits:

Method	Amount	Time
Refrigerator	1 lb.	5 - 6 hours
Room Temperature	1 lb.	3 - 4 hours
Cool Water	1 lb.	45 min.
Luke Warm Water	1 lb.	20 - 30 min

If the fruits have been packed in leak-proof packages invert the package while thawing. In using this technique the flavor and color will be more uniform.

2. Changes in Foods During Thawing

When vegetables are not properly scalded, through oxidation a loss of ascorbic acid (Vitamin C) occurs while thawing. Frost in some vegetables such as broccoli contains ascorbic acid and probably other vitamins and minerals. Therefore, the frost should become a part of the cooking water or used in some other way.

When properly handled, poultry and meat leak little during thawing with small danger of loss of nutrients by solution from these products. If not properly thawed, lean fish may lose as much as 20% of its weight by leakage. This leakage or drip then contains water soluble protein and minerals. 9/

9/ Faith Fenton, The Cooking of Frozen Foods Their Nutrutive Value, Cornell Bul. #628.

Some studies show that if peas are thawed in the unopened carton at room temperature there is little distruction of Vitamin C. 10/ However, when the peas are left at room temperature in an open container the loss is as great as 27% in one hour.

3. Cooking Frozen Foods

The changes in food value that may occur during the cooking of frozen foods are similar to those during the cooking of fresh foods.

4. Preparation of Vegetables

Cook frozen vegetables except corn on the cob, from the frozen state in as little water as possible to prevent scorching. One fourth cup of water is adequate for most foods. Cook in a covered pan. The factors which affect the amount of water needed is the amount of frost present in the food and the cooking time. The rate of evaporation will depend on size and shape of pan, and whether the pan is covered. On ranges where it is possible to control the heat, some frozen vegetables may be cooked without the addition of water.

To start the cooking process, the heat should be high until the steaming point is reached, then turn the control to a low setting and finish by steaming or boiling. Cook only enough frozen vegetables at a time to serve one meal.

It may be necessary to break stalky vegetables apart so they may be cooked in a small amount of water.

Likewise, leafy vegetables may be cut into cubes to insure uniform cooking. Thaw corn on the cob before cooking is started. If the whole ear is thawed before it is put into boiling water, the cob will be heated without the kernels being overcooked. If corn on the cob is packaged individually in aluminum foil, it may be cooked in the package.

Vegetables that are completely thawed before cooking shrink while cooking and become less attractive. The flavor is not as good, the Vitamin C and mineral contents are lowered

10/ R. R. Jenkins and D. K. Tressler and Fitzgerald. Vitamin C Content of Vegetables. Food Research Bul. #938

a. Cooking Time

Frozen vegetables require from one half to two thirds the time to cook as fresh ones because they have had their tissues softened and broken by the scalding and freezing process.

All uncooked frozen vegetables require some cooking. Generally, they are cooked by similar methods to those for fresh vegetables. Care must be taken not to overcook them For the first few times of cooking frozen foods, particularly frozen vegetables, keep a record of the time required to cook them to establish the desired standard.

It is difficult to give the exact time for cooking frozen foods as the cooking time depends upon:

(1) The variety.

(2) Maturity.

(3) Size of vegetable pieces.

(4) Length of time the vegetable is processed before freezing.

(5) Temperature of the food when put on to cook.

Follow a favorite recipe for seasoning frozen vegetables.

5. Preparation of Frozen Fruit

Frozen fruit need only slight thawing, enough to separate the pieces. Serve while a little frost remains in them. In this way, the structure and the shape of the fruit are retained and leakage is kept low. Peaches, aprocots, apples and pears require more thawing then do berries. Most completely thawed fruits are objectionable soft, and completely unthawed ones are too hard for desserts.

When frozen fruits are to be cooked, one of the easiest ways to defrost quickly is to empty the frozen fruit in a pan, turn the heat to a low setting, separate the block with a fork, and stir in the desired sugar. Allow the food to cook until tender.

Thaw fruits and berries used for pies and cooked desserts just enough to spread into the shell for baking.

Fruits used for short cake, puddings, and ice cream need to be partially thawed.

This is a guide for preparing frozen fruits:

a. Thaw in the carton and thaw only enough fruit to use at one meal.

b. Leave fruit in the sealed container or package until ready to use. If the package is broken, protect the fruit from exposure to air by pressing the edges of the liner or carton together. Oxygen tends to destroy the fresh flavor.

c. The method to use for thawing depends on how soon the fruit is to be eaten. Select the method suited to the time, (fast in a pan of cool water, or slow on a shelf of the refrigerator).

d. For desserts, serve fruit while there are still a few remaining crystals of ice.

e. For cooked desserts, heat quickly over low heat until fruit will spread easily.

6. Meats

In general, frozen meats may be cooked in any of the methods used for fresh meat of the same quality. Tender cuts may be cooked in the oven or broiled, the less tender ones require cooking with water, braising, or stewing.

a. Roasts

Most authorities recommend complete or partial thawing of roasts before cooking. Studies at Iowa State College indicate that roasts which are thawed before cooking requires a shorter cooking time and less fuel than roasts thawed during the cooking time. The thawed thawed roast has a greater total weight loss than the one thawed during the cooking.

The quality of the product is about the same for roasts thawed in the refrigerator, at room temperature, or in front of an electric fan.

Solidly frozen roasts require from 12 to 25 minutes more cooking per pound than do thawed roasts.

When a roast is cooked from the frozen state and as soon as it is thawed, place a meat thermometer in the roast so the bulb reaches the center of the meat just as it is done in a fresh roast. At this time, add salt and pepper and pour any leakage over the meat that may be in the pan. Roast in an uncovered pan in a moderate oven. Do not add water. Follow recommended roasting temperatures for reaching the desired doneness for the particular kind of meat. Remember pork should be cooked until well done or to an internal temperature of 185 F.

Braising, a method which uses moist heat, is suitable for cooking less tender cuts of meat.

b. Steaks, Chops, and Cutlets

These tender cuts of beef may be broiled from the frozen state allowing 10 to 15 minutes additional time per side according to the thickness. This method of cooking is not suitable for pork and veal.

Pan broiling of frozen meats should be started at a low temperature until the meat is completely thawed and then increasing the temperature. If a low temperature is not used the meat may be browned before the center is cooked.

c. Poultry

Partially or completely defrost poultry in the original package at room temperature or in the refrigerator. Thawed frozen poultry is cooked as in the unfrozen. If it is not completely thawed, additional cooking time is required. Like meat, the young tender birds can be cooked by dry heat, the older, less tender ones by moist heat.

Some of the common methods of cooking poultry are broiling, frying, roasting, and stewing. Use a standard recipe for the selected method.

d. Fish

Thaw fish slowly to prevent excess leakage. Some fish may be cooked from the frozen state. It takes additional cooking time.

Frozen fish may be cooked by any of the common methods used in cooking the unfrozen product. Use a tested recipe for cooking fish and seasoning.

7. Ready Cooked Foods

Frozen ready cooked foods need only to be heated not cooked. Prepare the foods quickly to prevent loss of quality. Add any required seasoning and heat quickly from the frozen state in a tightly covered pan, this is usually just long enough for it to become hot for serving.

Unbaked foods such as breads, pies, cakes, and cookies may be placed in the oven in the frozen state. It requires a longer cooking time than unfrozen foods. Baked breads, cakes, and cookies thaw relatively fast because they contain little moisture. Breads may be heated in the container or wrapping. Reheat baked pies in an oven at 35 to 375 F.

Most foods may be thawed in the sealed container. Such foods as salads, ice cream, and desserts require only slight thawing.

Unwrap frosted cakes immediately upon removal from the freezer to prevent the icing from sticking to the wrapping. When frozen baked foods are allowed to stand uncovered in the containers at room temperature, moisture condenses upon them as well as on the wrapping material. The result is the loss of crispness of the crust or icing.

Many ready cooked frozen foods tend to lose quality and to acquire a stale flavor after thawing or reheating. Therefore, only reheat or thaw enough food for one meal at a time.

Thaw sandwiches in their wrappings at room temperature for 1 to 2 hours or place them directly in the lunch box.

Quick preparation of frozen food for serving assures high quality and saves time.

With an adequate supply of frozen food available, the family may have better living each day of the year.

FREEZING BAKED GOODS

ITEM	FROZEN BEFORE BAKING	THAWING AND BAKING	FROZEN WHEN BAKED	THAWING AND REHEATING
YEAST ROLLS	PREPARE DOUGH, KNEAD, LET RISE ONCE, KNEAD AGAIN; SHAPE, PUT IN CONTAINER AND FREEZE AT ONCE. DO NOT HOLD IN FREEZER MORE THAN ONE WEEK.	REMOVE FROM PACKAGE, SET IN WARM PLACE TO DEFROST AND RISE, OR OVER 140 F. WATER. COVER WITH TOWEL. TAKES 1 TO 1½ HOURS.	PREPARE AS USUAL AND BAKE UNTIL SLIGHTLY BROWNED. LET COOL, PACKAGE SEAL AND FREEZE.	LET STAND WITHOUT UNWRAP-WRAPPING ONE HOUR, OR UNTIL DEFROSTED BUT STILL VERY COLD. REMOVE FROM PACKAGE AND REHEAT AT 400 DEGREES F. ABOUT 5 MINUTES.
YEAST BREAD	PREPARE AS USUAL, KNEAD, LET RISE ONCE. WRAP TIGHTLY AND FREEZE. A FEW LOAVES MAY BE SHAPED FOR EMERGENCIES. NOT ECONOMICAL TO FREEZE MANY, AS BREAD IS INEXPENSIVE BUT BULKY.	LET STAND WRAPPED IN REFRIGERATOR OVER NIGHT. (DO NOT DE-FROST AT ROOM TEMP-ERATURE.) AFTER DEFROSTING, KNEAD, SHAPE, PUT IN PAN IN WARM PLACE TO DOUBLE IN BULK. BAKE AS FOR FRESH BREAD.	PREPARE AS USUAL, BAKE, LET COOL, WRAP, SEAL AND FREEZE.	DEFROST 1 HOUR, AT ROOM TEMPERATURE; BEST IF USED SOON AFTER DEFROSTING.
BAKING POWDER BISCUITS	PREPARE AS USUAL. MAY BE FROZEN ON SHEET PAN BEFORE PACKAGING, OR PACK-AGED AND THEN FREEZE.	REMOVE FROM PACKAGE, DEFROST AT ROOM TEMP-ERATURE ABOUT 1 HR. BAKE AT 425 F. ABOUT 15 MIN. UNTIL GOLDEN BROWN. MAY BE BAKED WITHOUT DEFROSTING AT 300 DEGREES F. FOR 15 MIN. OR UNTIL FULLY RISEN, FINISHED IN HOT OVEN 425 DEGREES F. 10 TO 15 MINUTES.	PREPARE AS USUAL, BAKE UNTIL LIGHTLY BROWNED, LET COOL, PACKAGE, SEAL AND FREEZE.	ALLOW TO DEFROST IN PACKAGE AT ROOM TEMPERA-TURE. REHEAT IN HOT OVEN, 400 DEGREES F. FOR 5 TO 8 MINUTES.

ITEM	FROZEN BEFORE BAKING	THAWING AND BAKING	FROZEN WHEN BAKED	THAWING AND RE-HEATING
MUFFINS	PREPARE BATTER, FILL PAPER BAKING CUPS 2/3 FULL. FREEZE BEFORE WRAPPING, STACK CUPS, AND PACKAGE, SEAL AND FREEZE. OR PLACE CUPS IN PACKAGE AND FREEZE. BE SURE PACKAGE IS IN CONTACT WITH WALLS OR FLOOR OF FREEZER.	REMOVE FROM CARTON, PLACE CUPS IN MUFFIN PANS. BAKE AT 300 F. UNTIL FULLY RISEN. [illegible] 15 MIN., FINISH IN HOT OVEN, 425 F. UNTIL GOLDEN BROWN, OR DEFROST 1 HR. AT ROOM TEMPERATURE. BAKE AS FOR FRESH MUFFINS.	PREPARE AND BAKE AS USUAL. LET COOL ON RANGE IN BOXES OF SUITABLE SIZE, LINED WITH MOISTURE-VAPOR-PROOF MATERIAL AND FREEZE IN POLYETHELYNE BAGS.	LET STAND IN PACKAGE ONE HOUR AT ROOM TEMPERATURE REHEAT IN HOT OVEN, 400 F., 5 - 8 MINUTES.
COOKIES	PREPARE REGULAR REFRIGERATOR COOKIES; SHAPE IN ROLL OR BAR, FREEZE. DROP COOKIES MAY BE FROZEN ON SHEET AND PACKAGED.	OPEN AND FOLD BACK WRAPPER AT ONE END OF BAR OR ROLL, SLICE OFF AS MANY COOKIES AS NEEDED. IF TOO HARD TO CUT, LET STAND A FEW MINUTES. DEFROST NO MORE THAN WILL BE BAKED. BAKE AT 350 - 375 F. ABOUT 10 MINUTES. PLACE DROP COOKIES ON SHEET WITHOUT [illegible] BAKE AT 325 F. FOR 10 TO 12 MINUTES.	PREPARE AND BAKE ANY COOKIES. LET COOL, AND PACKAGE, SEAL AND FREEZE, WILL KEEP WELL FOR SEVERAL MONTHS.	LET STAND IN [illegible] ABOUT $\frac{1}{2}$ HOUR. DEFROSTING TIME WILL DEPEND ON SIZE OF COOKIES AND SIZE OF PACKAGE.

ITEM	FROZEN BEFORE BAKING	THAWING AND BAKING	FROZEN WHEN BAKED	THAWING AND REHEATING
PIE CRUST	PIE CRUST MAY BE FROZEN AND HELD FOR SEVERAL WEEKS, BUT MORE SATISFACTORY TO FREEZE PIES. WRAP TIGHTLY, SEAL AND FREEZE.	DEFROST OVERNIGHT IN REFRIGERATOR. DEFROSTING MORE RAPID AT ROOM TEMPERATURE, BUT CARE MUST BE TAKEN NOT TO LET PASTRY GET WARM, AS QUALITY IS NOT AS GOOD.	NOT RECOMMENDED.....	
TWO CRUST PIES	MAKE AS USUAL EXCEPT DO NOT CUT UPPER CRUST. IF PEACH OR APPLE, FRUIT SHOULD BE TREATED TO PREVENT BROWNING (APPLES IN STEAM, PEACHES IN ASCORBIC ACID). ROLL LOWER CRUST SLIGHTLY THINNER THAN USUAL, SPRINKLE WITH FLOUR OR CORNSTARCH, BRUSH WITH WHITE OF EGG OR MELTED FAT BEFORE ADDING FILLING TO PREVENT SOGGINESS. METAL, GLASS, OR STURDY PAPER PLATES MAY BE USED. PIES MAY BE WRAPPED BEFORE OR AFTER FREEZING.	REMOVE WRAPPER, PLACE IN PRE-HEATED OVEN. FOR A 7" - 8" PIE, BAKE IN HOT OVEN AT 400 F., 45 - 50 MIN. FOR A 9" PIE, BAKE AT 400 F., 50 - 60 MIN.	BAKE PIE AS USUAL, LETTING IT BROWN VERY LITTLE IF TO BE REHEATED. LET COOL, WRAP TIGHTLY, SEAL AND FREEZE.	IF PIE IS TO BE SERVED COLD, LET STAND AT ROOM TEMPERATURE 8 HOURS, OR OVERNIGHT. IF IT IS TO BE SERVED HOT, UNWRAP AND PUT IN OVEN SAME LENGTH OF TIME AND AT SAME TEMPERATURE AS UNBAKED PIE.

ITEM	FROZEN BEFORE BAKING	THAWING AND BAKING	FROZEN WHEN BAKED	THAWING AND REHEATING
CUP CAKES	PREPARE CAKE BATTER, POUR INTO BAKING CUPS, FREEZE BEFORE OR AFTER PACKAGING. SEAL AND FREEZE.	BAKED WITHOUT DEFROSTING. PUT IN SLOW OVEN 275 F. UNTIL CAKES ARE FULLY RISEN AND ROUNDED ON TOP ABOUT 15 MINUTES. FINISH IN MODERATE OVEN, 350 F. ABOUT 20 MINUTES. DEFROSTED THEN BAKED: REMOVE FROM PACKAGE AND LET STAND AT ROOM TEMPERATURE 1 HOUR. BAKE AS FOR FRESHLY PREPARED CAKE.	PREPARE AS USUAL. COOL, PACKAGE, SEAL, AND FREEZE.	LET STAND IN PACKAGE AT ROOM TEMPERATURE ABOUT ONE HOUR.
LOAF OR LAYER CAKE	POUR BATTER INTO GREASED PANS, WRAP AND FREEZE. OR POUR BATTER INTO LINED BOXES. SEAL AND FREEZE.	DEFROST 1 – 2 HOURS, (DEPENDING ON THICKNESS) BAKE AS FOR FRESHLY PREPARED BATTER. OR LET BATTER DEFROST, POUR INTO GREASED PANS, AND BAKE.	SAME AS FOR CUP CAKES	
SPONGE OR LAYER CAKES	SAME AS FOR LAYER CAKE		USE REGULAR RECIPE. BAKE, LET COOL, WRAP, SEAL AND FREEZE.	LET WRAPPED UNICED CAKE STAND AT ROOM TEMPERATURE ABOUT ONE HOUR.

FROSTING ** CAKES MAY BE FROSTED AFTER AFTER FREEZING OR A BUTTER FROSTING MAY BE PUT ON CAKES BEFORE FREEZING. IF FROSTED BEFORE FREEZING, CAKE SHOULD BE FROZEN BEFORE PACKAGING.